# Appendix 5-J

## WILD HORSE RIDGE

## BLIND CANYON SEAM PAD

## AND CONVEYOR ACCESS ROADS

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## Introduction

This Appendix discusses the construction of the Wild Horse Ridge conveyor belt access roads and the Blind Canyon Seam (Bear Canyon No. 3 Mine) portal pad. Cut and Fill volumes have been determined for the roads and pad and are summarized in Table 5J-1. Also included is an operational slope stability analysis and a reclaimed slope stability analysis. Pre-mining, Operational and Post-mining cross-sections are detailed in Attachment B of this Appendix.

## Construction Description

Construction will begin with the Lower Conveyor Access Road and the topsoil storage area. Drainage control structures will be established prior to any work beginning. This will include the stream bypass culvert and Catch Basin “1". Initially, the topsoil storage area will be cleared of any trees and graded to generate a stable base for the pile. Starting at the bottom of the road, shown on Plate 5-2F, topsoil will be removed from all areas where fill is to be placed, and will be stockpiled. Topsoil will be removed from the projected cut areas (Attachment B, segments B and C, Dames & Moore Report, pp. 3-4) and placed in the stockpile. Then material will be removed from the road cut (Segment A) and compacted onto the lower fill areas of the road (Segments B and C). As the cut progresses up the road, topsoil will be removed prior to the road cut being made and placed in the storage pile. Cuts will be made using the sequence shown in Figures 5G-1 and 5G-2, shown for the constructed Tank Seam Access Road.

## Table 5J-1

**Summary of Cut and Fill Volumes**

| Area | Cut Vol. (Cu Yds) | Topsoil (Cu Yds) | Fill Vol. (Cu Yds) | Excess (Cu Yds) | Avg haul dist. |
|---|---|---|---|---|---|
| Lower Conveyor Access Road | 3,324 | ~1,669 | 1,336 | 319 fill | 250 ft |
| Upper Conveyor Access Road | 4,933 | ~2,171 | 2,766 | 4 cut | 160 ft |
| Blind Canyon Seam Portal Pad | 15,750 | ~4,860 | 10,556 | 51 cut | 220 ft |

During the initial road cut, care will be taken to prevent disturbed material from migrating down slope in the following manner. The initial topsoil removal will be made using a backhoe. Trees and/or shrubs immediately ahead of the cut will be removed by pulling them back into the previous cut. Using the backhoe, a berm will be created on the downhill side of the cut, as shown in Figure 5-G1. When the berm is in place, the road cuts will be started as shown in Figures 5-G1 and 5-G2 using a backhoe and/or front-end loader. The road cuts will be made into the slope towards the cut face rather than parallel to the slope, which will result in any rocks or sloughage dislodged by the equipment bucket during the road cutting to be contained within the berm. In the event blasting is required, which is described in Appendix 5-E, the blasts will be designed to drop the material into the cut area behind the berm. This will prevent material generated by the blast from migrating down slope into the undisturbed area.

Cut slopes, fill slopes, and fill placement will follow the recommendations given in the Slope Stability analysis and report, included on pages 5J-17 through 5J-47. Large boulders will also be placed according to the report. Where possible, care will be taken to avoid disturbing large trees of commercial value and any canyon sweetvetch plants located in the area (see chapter 3).

Final crowning of the road and installation of permanent ditches will be completed following the initial road contouring. The approximate proposed road contours are shown on Plate 5-2F. The 319 excess yards of material from the cut will be used as fill across the Bear Creek culverted crossing.

The Upper Conveyor Access Road, shown on Plate 5-2G, will be constructed using the same method. Initially, Catch Basin “2" will be constructed. Topsoil will be hauled below to the storage pile as it is recovered. Drainage crossings will be installed in the ephemeral stream as each crossing is reached so undisturbed and disturbed drainage will be continually segregated. This will prevent sediment loading in the event a rainstorm occurs during construction, and will protect the catch basin from undisturbed drainage. A small riparian area exists adjacent to this road. Care will be taken to prevent any material from migrating down slope from the road cut into this riparian area. Construction of this road will require the removal of several large trees having commercial value. Where possible, these trees will be harvested and sent to a sawmill to provide valuable commercial use. The Division will be notified when any blasting will take place above spring SBC-14, and when Culvert C-34U is to be installed above the spring, in time to allow a Division hydrologist to make a field visit during the blasting

Excess cut material from the two conveyor access roads will be used to construct the Bear Creek culverted crossing, which will replace the bridge, which currently provides access across the creek. During installation of this culvert, care will be taken to avoid excessive material from impacting Bear Creek. This will be accomplished by placing the culvert in the creek bed. Large rocks and debris will be removed from the creek channel to insure a firm, level surface to place the culvert on. After all of the water has been channeled into the culvert, fill material will be placed on each side of the culvert simultaneously using a track hoe. This will prevent the culvert from shifting or moving during installation. Once the culvert has been filled across, remaining fill will be placed to complete the construction of the road. All activities will be completed in accordance with the approved Stream Alteration Permit, which will be obtained from the State Division of Water Rights.

After the access roads are in place, construction will begin on the Blind Canyon Seam Portal Pad. Temporary and permanent silt fences will be placed below the fill area prior to equipment entering the proposed disturbed area. The silt fences will be placed so as to treat runoff from all disturbed area not contained by a berm during construction. All temporary silt fences will remain in place and be maintained until construction of the sediment pond is completed and all runoff has been directed to the sediment pond.

Topsoil recovery will then begin along the access road approaching the pad. A pilot road will be constructed through the fill area during topsoil recovery activities, providing access into the drainage where the fill is to be placed. Topsoil will be hauled to the storage area shown on Plate 5-2F.

After topsoil recovery activities have been complete and all trees removed from the area, the culvert will be installed for the undisturbed drainage to pass the disturbed area. A dozer will be used to cut the material from the access areas and push it into the fill area. Fill material will be placed in lifts not to exceed 36", as described in the slope stability report. The conveyor belt tunnel will be constructed in the fill in conjunction with filling activities to avoid re-disturbing the compacted fill. As the fill nears the elevation of the coal seam, the coal seam and highwalls at the portal locations will be faced up, exposing the seam. Since the majority of the coal outcrop is already exposed, little coal waste material is expected from the face-up operations. Any material with significant amounts of coal in it will be hauled to the Coal Storage Pad area and processed in accordance with R645-301-511.200.

The out slope of the fill area will be constructed at a slope of 2H:1V, as described in the slope stability analysis report. As soon as possible after the slope has been constructed, erosion control matting will be placed as described in Appendix 7-K to control erosion. The slope will be seeded using the interim seed mix described in Chapter 3.

Following the initial road and pad contouring, the sediment pond will be constructed. Then the final crowning of the road and pad and the installation of permanent ditches and culverts will be completed.

The remaining portions of the access road existed prior to mining activities. Minimal upgrading will be required on this road. If any areas of the road require widening, the material generated from this will be incorporated into the pad fill. All required ditches and culverts will be constructed as soon as practical to insure protection of the hydrologic balance.

**Cut and Fill Calculations**

The cut and fill volumes shown in Table 5J-1 represent the maximum volumes which will be encountered. Final contours and pad dimensions may vary somewhat to account for any variation in cut and fill volumes. As-built contours and cut and fill volumes will be submitted to the Division following construction.

Volume measurements were made using the "Quicksurf" 3-D modeling software with AutoCad. They are based on the contours shown on Plates 5-7F and 5-7G for pre-mining configuration, Plates 5-2F and 5-2G for operational configuration, and Plates 5-6F and 5-6G for post-mining configuration. Cross-sections for each configuration are included in Attachment B.

Figure 5J-1 shows the locations of cross-sections for the Lower Conveyor Access road. It is proposed to reclaim this area as close as possible to the pre-mining configuration, so the proposed post-mining cross-sections have been represented by the pre-mining cross-sections. The representative volumes for each cross-section are shown in Table 5J-2. The excess 319 yards of material will be used as fill for the Bear Creek culvert crossing.

Table 5J-2

Lower Conveyor Access Road
Cut and Fill Volumes

| | **Const. Vol. (Cu yds)** | | Cum.Vol. | **Reclaimed Vol. (cu yds)** | | Cum. Vol. |
|---|---|---|---|---|---|---|
| Station | Fill (-) | Cut (+) | (cu yds) | Fill (-) | Cut (+) | (cu yds) |
| -1+00 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0+00 | 101 | 13 | -88 | 13 | 101 | 88 |
| 1+00 | 94 | 26 | -156 | 26 | 94 | 156 |
| 2+00 | 411 | 132 | -435 | 13 | 411 | 435 |
| 3+00 | 730 | 266 | -899 | 550 | 730 | 615 |
| 4+00 | 0 | 1,070 | 171 | 821 | 0 | -206 |
| 5+00 | 0 | 1,143 | 1,314 | 731 | 0 | -937 |
| 6+00 | 0 | 674 | 1,988 | 674 | 0 | -1,611 |
| Topsoil | **1,669** | ---- | **319** | --- | **1,669** | **58** |
| Total | **1,336** | **3,324** | **319** | **2,947** | **1,336** | **58** |

There is an estimated topsoil volume of 1,669 cu yds which will be salvaged during construction of this road. This topsoil will be stored in the storage area adjacent to the road, as shown on Plate 5-2F.

Figure 5J-2 shows the locations of cross-sections for the Upper Conveyor Access Road. The cut and fill material for this area has been balanced to avoid hauling material to other areas. This area will also be reclaimed as close as possible to the pre-mining configuration, so the proposed post-mining cross-sections have been represented by the pre-mining cross-sections. The representative volumes for each cross-section are shown in Table 5J-3. An estimated topsoil volume of 2,171 cu yds will be salvaged during construction of the road. The topsoil will be hauled to the storage area shown on Plate 5-2F.

Figure 5J-1 Lower Conveyor Access Road Cross-Section Stations

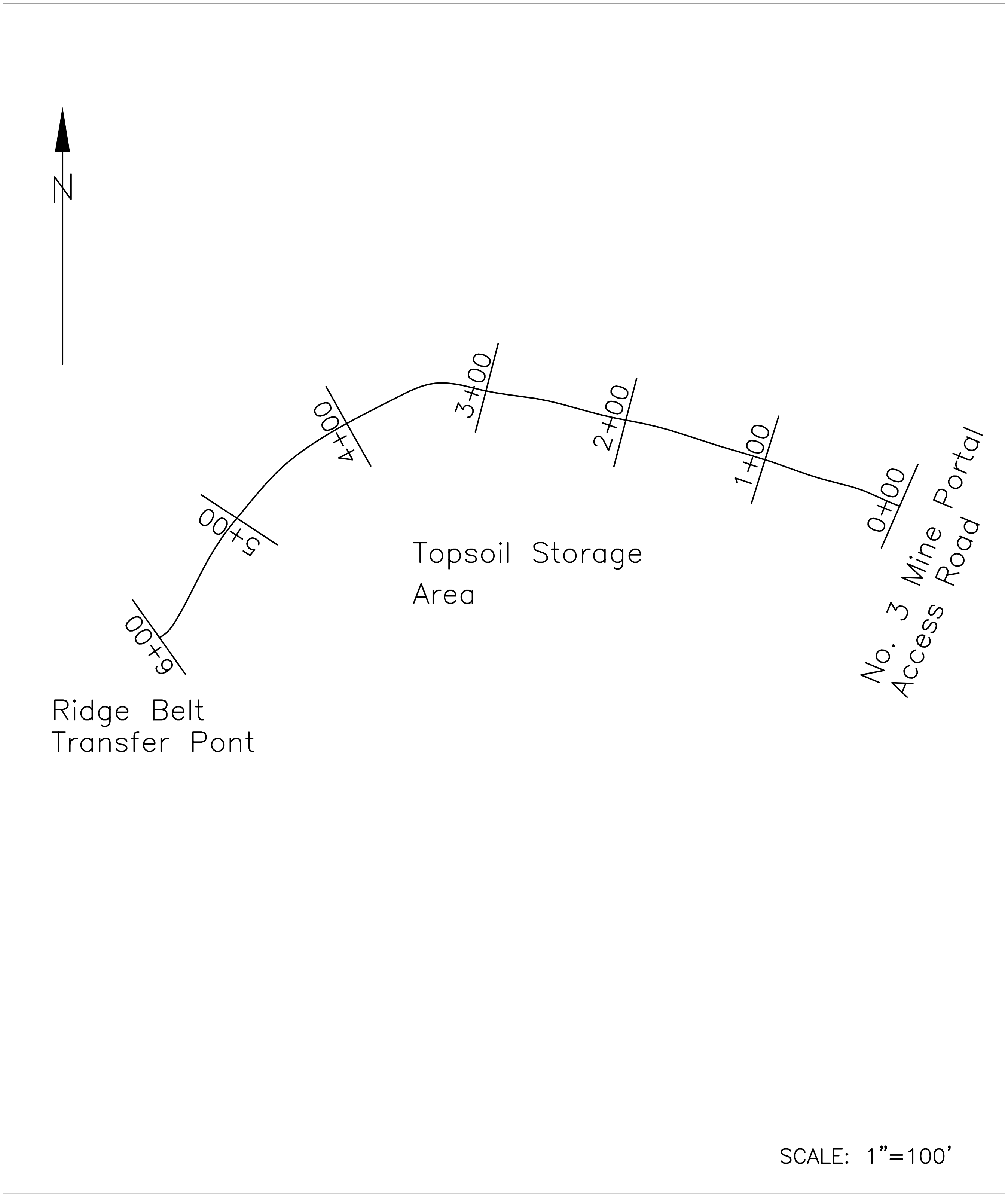

Table 5J-3
Upper Conveyor Access Road
Cut and Fill Volumes

| Station | **Const. Vol. (Cu yds)** Fill (-) | Cut (+) | Cum. Vol. (cu yds) | **Reclaimed Vol. (cu yds)** Fill (-) | Cut (+) | Cum. Vol. (cu yds) |
|---|---|---|---|---|---|---|
| -1+00 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0+00 | 754 | 22 | -732 | 22 | 190 | 168 |
| 1+00 | 1,097 | 355 | -1,474 | 355 | 1,097 | 910 |
| 2+00 | 32 | 1,652 | 146 | 672 | 32 | 270 |
| 3+00 | 472 | 156 | -170 | 156 | 472 | 652 |
| 4+00 | 218 | 984 | 596 | 1,182 | 28 | -502 |
| 5+00 | 100 | 1,536 | 2,032 | 1,536 | 0 | -2,038 |
| 6+00 | 93 | 228 | 2,167 | 228 | 93 | -2,173 |
| Topsoil | **2,171** | — | -4 | --- | **2,171** | -2 |
| Total | **2,766** | **4,933** | **-4** | **4,085** | **1,912** | **-2** |

Figure 5J–2 Upper Conveyor Access Road Cross–Sections

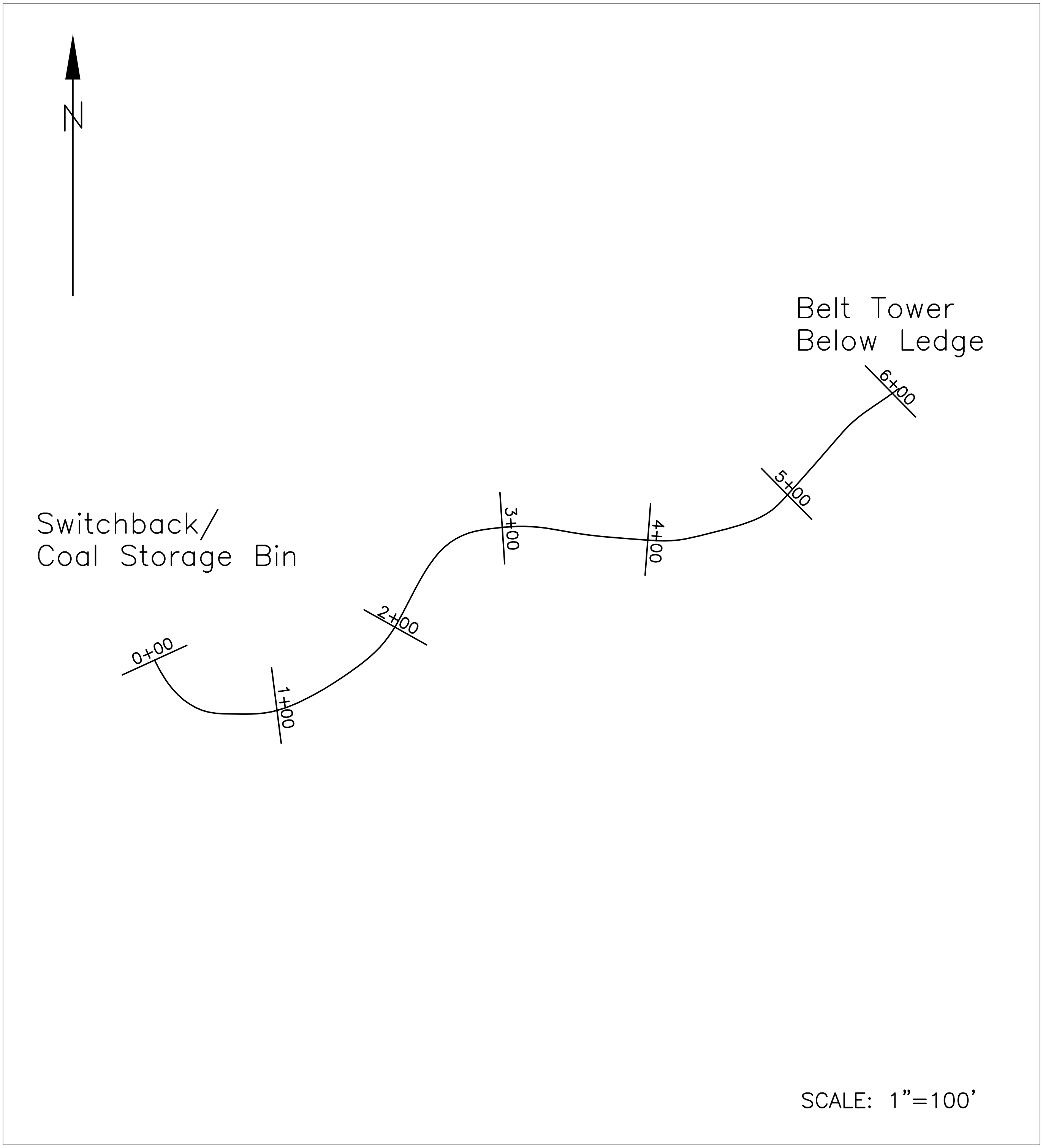

Figure 5J-3 shows the locations of cross-sections for the No. 3 Mine Portal Pad area. The construction sequence will start with the recovery of the topsoil located on the existing cut bench above the proposed pad area. Initial topsoil on the slopes will be recovered using a track hoe to reach approximately 15' below the bench. A pilot road cut will then be made using the track hoe, and the material will be pulled back onto the bench. As the pilot cut proceeds into the bottom of the canyon, the topsoil will be removed from the lower slopes wherever the track hoe can reach. This process will continue until the pilot cut reaches the drainage area where the pad fill is to be placed.

Once access into the drainage has been constructed, the crews will proceed to recover all of the topsoil, which will be hauled to the topsoil storage area shown on Plate 5-2F. An estimated volume of 5,143 cu yds of topsoil material will be recovered. After the topsoil has been removed, the fill will be placed as described in this Appendix. Table 5J-4 shows the calculated cut and fill volumes. The contours of the pad out slope may vary slightly to account for the shortage in cut volumes shown in the Table.

During construction 1,000 $yds^3$ of material was excavated and moved from TS-15 to TS-11 to allow for construction of the tunnel. Once construction was completed 1,000 $yds^3$ of material was hauled from TS-17 to backfill the tunnel in TS-15 and the material in TS-11 was left there for reclamation.

During reclamation, the cut and fill process will be reversed. The reclaimed slopes will be reconstructed to approximate original contour, with the exception that localized ridges between drainages will be varied slightly from the original contours. In addition, a portion of the cut slope, shown on Plate 5-6G, will remain in place due to slope stability requirements. This will provide additional material, which will be used to eliminate to the extent possible the bench cut which existed prior to mining. This variation is shown in portal area cross-sections 1+00, 2+00, and 3+00.

Figure 5J-3 No. 3 Mine Portal Area Cross-Section Stations

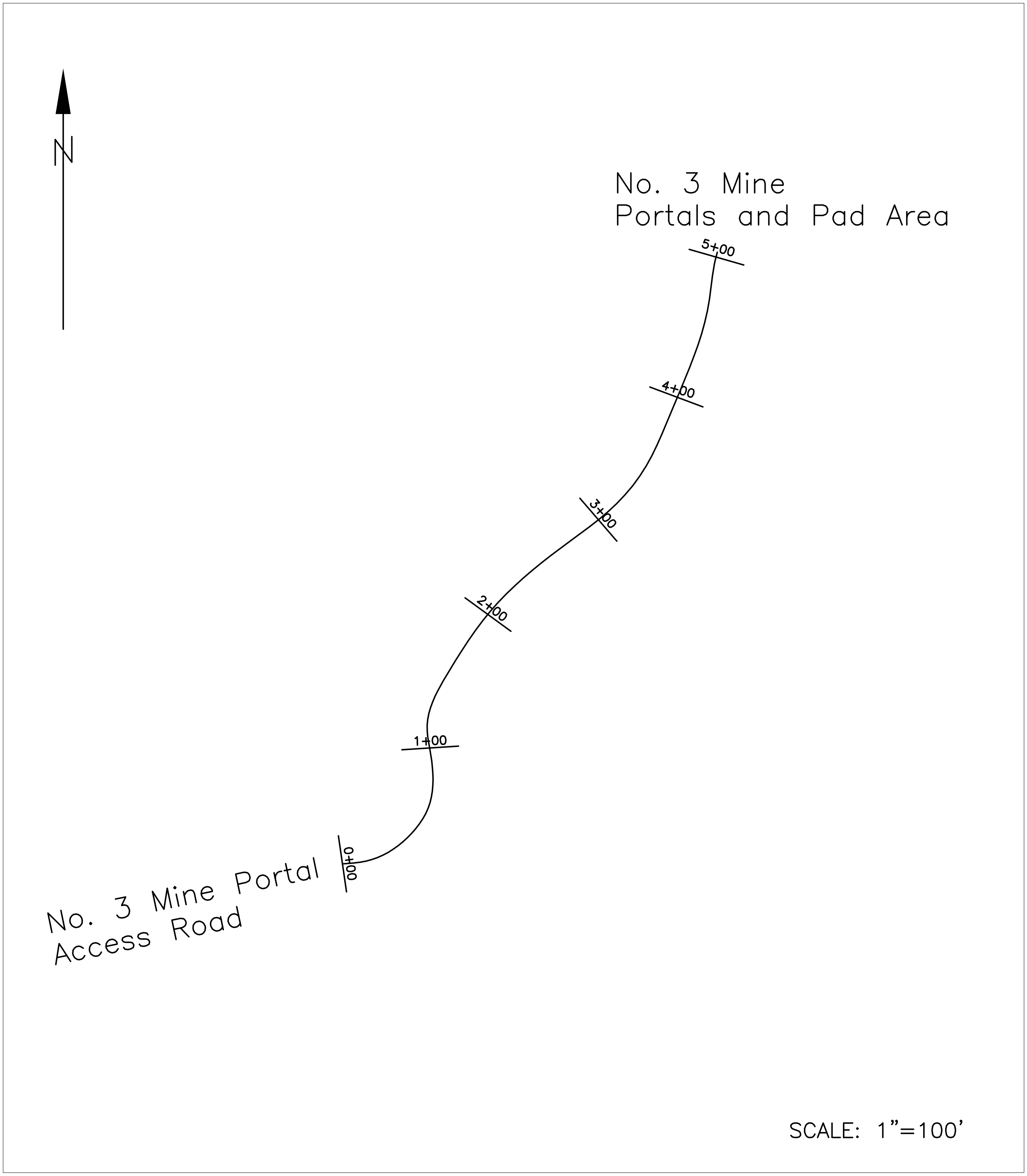

Table 5J-4
No. 3 Mine Portal Area
Cut and Fill Volumes

| | **Const. Vol. (Cu yds)** | | Cum. Vol. | **Reclaimed Vol. (cu yds)** | | Cum. Vol. |
|---|---|---|---|---|---|---|
| Station | Fill (-) | Cut (+) | (cu yds) | Fill (-) | Cut (+) | (cu yds) |
| -1+00 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0+00 | 0 | 153 | 153 | 591 | 0 | -591 |
| 1+00 | 0 | 960 | 1,113 | 1,363 | 0 | -1,954 |
| 2+00 | 0 | 2,865 | 3,978 | 2,950 | 260 | -4,644 |
| 3+00 | 1,299 | 4,174 | 6,853 | 6,990 | 369 | -11,265 |
| 4+00 | 6,254 | 6,126 | 6,725 | 2,464 | 6,254 | -7,475 |
| 5+00 | 3,405 | 1,572 | 4,892 | 786 | 3,405 | -4,856 |
| Topsoil | **4,860** | — | -51 | --- | **4,860** | 4 |
| Total | **15,818** | **15,850** | **32** | **15,144** | **15,148** | **4** |

Attachment A contains a slope stability analysis  the operational cross-sections for the stations shown in Figures 5J-1, 5J-2 and 5J-3. Attachment B contains the A slope stability analysis of the reclaimed cross-sections. Appendix A of Attachment B illustrates the cross-sections, showing the pre-mining configuration, the proposed operational configuration, and the proposed post-mining configuration.

# Attachment A

# Slope Stability Analysis
# Operational Phase

REPORT
SLOPE STABILITY EVALUATION
WILD HORSE RIDGE, BEAR CANYON NO.
CONVEYOR SYSTEM ACCESS ROAD
HUNTINGTON CANYON
For
CO-OP MINING COMPANY

JOB No. 27437-005-162
OCTOBER 7, 1996

DAMES & MOORE

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October 7, 1996

CO-OP Mining Company
P.O. Box 1245
Huntington Canyon
Huntington, UT 84528

Attention: Mr. Charles Reynolds
Mining Engineer

**Report**
Slope Stability Evaluation
Wild Horse Ridge, Bear Canyon No. 3
Conveyor System Access Road
Huntington Canyon
Job No. 27437-005-162

## INTRODUCTION

This report presents the results of our slope stability evaluation for the proposed conveyor system access road and staging area at Wild Horse Ridge, Bear Canyon No. 3 near Huntington Canyon, Utah. The approximate road alignment with respect to major topographic features and existing facilities is presented on Plate 1, Vicinity Map. Plates 2A and 2B show the anticipated alignments of the lower and upper sections of the access road, respectively.

## SCOPE OF STUDY

The scope of work for this investigation was outlined in our proposal, dated August 19, 1996. Authorization to perform the work was provided by signature on August 26, 1996. In general, the purpose of the investigation was to aid in the feasibility and permitting process of the access road by performing stability analyses at representative sections. In accordance with that purpose, the following services were performed:

1) Completing an engineering geology reconnaissance of the proposed access road alignment and proposed portal staging area. The reconnaissance included estimating depths of surficial deposits, completing field descriptions of surficial and bedrock deposits, obtaining bulk samples for laboratory testing, and identifying representative areas for subsequent stability analyses.

2) Performing laboratory tests to aid in the determination of strength parameters.

3) Performing slope stability analyses for selected sections of the access road and providing recommendations to improve slope stability. Additionally, recommendations for access road cuts and placement of fill at the proposed staging were provided.

## PROPOSED CONSTRUCTION

CO-OP mine is anticipating mining new coal seams in the Wild Horse Ridge area. The portal location can generally be accessed by an existing road, however, the canyon below the portal area will be filled to allow for portal access and construction staging. Coal from the mine will be transported to the current processing facility via a new conveyor system.

An access road will be constructed in order to build the conveyor system and to allow for conveyor maintenance. The access road will consist generally of a lower and upper section, as indicated on Plates 2A and 2B. It is our understanding that material excavated during construction of the Lower Access Road will be used in adjacent segments to fill low areas, particularly at drainage crossings. Excavated material from the Upper Access Road will be used primarily to improve the main access road or fill in low areas of adjacent segments.

## FIELD RECONNAISSANCE AND LABORATORY TESTING

### FIELD RECONNAISSANCE

A field reconnaissance was completed along the lower and upper sections of the proposed conveyor access road and at the proposed portal area. Descriptions were completed for segments along each section where engineering properties differ from adjacent segments. Additionally, representative samples were obtained from surficial deposits for laboratory testing. Soil and rock descriptions for each segment identified are subsequently presented. The segments described are delineated on Plates 2A and 2B.

## LOWER SECTION

### Lower Section, Segment A

This segment generally consists of 3 to 5 feet of colluvial soils overlying sandstone bedrock. The colluvial soils are predominantly gravel with cobbles and boulder in a silty sand matrix. The percentage of material is estimated as follows:

| | | |
|---|---|---|
| gravel - | 40% | |
| fine to coarse sand - | 20% | |
| silty fines - | 15% | |
| cobbles and boulders - | 25% | (angular boulders routinely exceed 3 feet in width.) |

The slopes are stable at approximately 35 to 45 degrees with the majority of the slopes comprised of sandstone ledges with shallow surficial deposits. Vegetation consists of cedar, pinion pine and engleman spruce. It is estimated that one-third to one-half of the road will encountered bedrock where blasting will be required. Cuts on the order of 8 feet in height are anticipated in the bedrock.

### Lower Section, Segment B

This segment is located at the base of the steeper slope comprising segment A and is above the flood plain of the drainage, as indicated on Plate 2A. Surficial deposits are estimated to be 7 to 10 feet in depth and consist of sandy gravel with cobbles and boulders. Estimated composition is as follows:

20% cobbles and boulders to 5 feet in width
40% fine to coarse sandstone gravel
25% fine to coarse sand
15% silty fines

In this segment excavated material from Segment A will be used to fill in two small drainages and to fill low areas. The majority of this segment will be at grade or on several feet of fill. Vegetation is the same as in segment A, however, sparse grass and sage brush and occasional large pine trees are present.

**Lower Section, Segment C**

This segment consists of colluvial and stream deposits. The estimated percentage of material is as follows:

30% gravel
30% sand
20% fines
20% cobbles and boulders to 5 feet in width.

This segment will be at grade or on fill, particularly where the drainage is crossed. This segment is more heavily vegetated than the upper segments. Vegetation consists of sagebrush, occasional cottonwood trees and juniper trees. A culvert will be required at the drainage crossing. A bulk sample was obtained in this segment.

## UPPER SECTION

**Upper Section, Segment A**

The conveyor access road in this area will branch from the main access road. The drainage northwest of the road alignment contains abundant vegetation and a small amount of water flows in the drainage. In order to preserve the vegetated area, the road alignment will be shifted to the southeast to avoid the drainage. Excavated material from this segment will be used to reduce the grade of the main access road as it approaches this section and to widen out the switchback on the main access road.

The road in this area will be cut into colluvial deposits and weathered bedrock. Due to the alignment, it is anticipated that one-half of the road will be in colluvial deposits and one-half in weathered bedrock. Uphill cuts in excess of 10 feet high may be required. The colluvial deposits are currently at a slope of 40 to 45 degrees and are expected to exceed 7 feet in depth. The colluvial deposits are composed largely of weathered shaley siltstone with silty and clayey fines comprising over 50 percent of the total material. A bulk sample was obtained in this segment.

Bedrock consists on laminated to thinly bedded shaley siltstone with up to 6-inch thick sandstone beds. The siltstone is moderately soft, moderately to intensely weathered (tends to air slake), and moderately jointed. Joints are closely spaced and closed to 1/8-inch separation. The bedrock stands vertically where previously cut, however, raveling of the slope has occurred. Several minor seeps were noted in the bedrock above the alignment causing damp areas.

**Upper Section, Segment B**

This segment has approximately 3 to 5 feet of colluvial soils overlying sandstone bedrock. The majority of the cut in this section will be in bedrock. Cuts of 8 to 10 feet in height are anticipated on the uphill side of the road.

Bedrock consists of moderately soft to moderate hard sandstone. The sandstone is thinly to moderately bedded and moderately jointed with joint spacing at approximately 6 inches. The trend of the major joint sets is parallel to the road alignment. The joints are open, dry, contain no filling and are moderate to intensely weathered.

Colluvium consists of sandy gravel with cobbles and boulders with the following estimated percentages:

40% cobbles and boulder (boulders tend to be slabs to 6 ft.)
30% gravel
20% sand
10% fines

The slopes in this area are 55 to 60 degrees with vertical sandstone ledges.

**Upper Section, Segment C**

The road in this section will be largely on colluvial soils or stream deposits. The general soil composition is as follows:

20% cobbles and boulders to 6 feet in width
20% subrounded to angular sandstone gravel
40% fine to coarse sand
20% silty fines

The surficial deposits throughout this segment are expected to range from 8-10 feet in depth. The upper foot of surficial deposits contains abundant organics and is classified as topsoil. Excavated material from Segment B will be placed in low areas to stabilize the roadway. A culvert will be installed in the drainage and excavated material from Segment B will also be used as backfill against the culvert. The majority of this segment will be on fill. Abundant large pine trees are present throughout the alignment.

**Upper Section, Segment D**

This section crosses through material that was side-cast during construction of the main access road. The upper end of this section will encountered massive sandstone ledges. A major sandstone ledge is located above the alignment and it is expected that the surficial material between the road alignment and the ledge will have to be removed to prevent excessive raveling. The older trees are "knee-bent" and have accumulations of previous side-cast material on the uphill side. Although the side cast material is generally less than 3 feet deep, it may have to be removed to minimize excessive raveling. The maximum estimated depth of surficial deposits is 7 feet.

The surficial material is largely coarse grained material with the following percentages:

5% boulders to 6 to 8 feet in width
20% cobbles
20% gravel
30% fines
25% sand

Grasses are abundant and may indicate areas of seepage during spring months. The area was dry during our reconnaissance of 9/10/96. Uphill cut slopes on the order of 10 feet in height are anticipated in this segment.

The upper part of this segment will be cut predominantly into sandstone bedrock. The bedrock is moderately hard sandstone with the major joint set at N 10° E with a vertical dip. A N 70° E at 70-90°NW joint set was also noted. Joints are spaced six inches to one foot apart. Joints are open ¼ to 1 inch with rough sidewalls and no infilling. Bedding thickness varies from thinly bedded to massive. Bedding is slightly crossbedded at an orientation of S30°E and a dip of approximately 5 degrees. Overall the rock mass tends to part on bedding planes. A 4 to 5 foot thick coal seam is located near the bottom of the bedrock in this section.

## LABORATORY TESTING

Two bulk samples were obtained from the alignment for laboratory testing. Bulk sample 1 (TP-1) is representative of the majority of colluvial/stream deposits overlying sandstone bedrock while bulk sample 2 (TP-2) is representative of the material below or adjacent to the shaley siltstone ledge in segment A of the upper section.

Mechanical gradation analyses were completed on both samples. The coarser material (greater than 3 inches) was not included in the gradation from bulk sample 1. The gradations are presented in the following table.

| Bulk Sample | Percent Gravel (>No. 4 Sieve) | Percent Sand (<No.4 >No. 200 Sieve) | Percent Fines (< No. 200 Sieve) | USCS Classification |
|---|---|---|---|---|
| TP-1 | 57 | 26 | 17 | GM |
| TP-2 | 11 | 18 | 71 | ML |

The gradation curves are presented in the Appendix.

Direct shear tests (consolidated undrained) were also completed on each sample. The results are indicated in the following table.

| Bulk Sample | Friction Angle (total stress) | Cohesion (psf) |
|---|---|---|
| TP-1 | 31 | 0 |
| TP-2 | 34 | 0 |

The friction angle for TP-1 is indicative only of the material finer than the no. 4 sieve. Thus, the contribution from the coarser material is not included. Therefore, a more realistic friction angle of 34 degrees was used for subsequent analyses.

## SLOPE STABILITY ANALYSES

### ROCK PROPERTIES

In order to develop bedrock strength parameters for use in the stability analyses, the bedrock was classified according to the Rock Mass Rating (RMR) System (Bieniawski, 1988). The RMR classification system evaluates five parameters from which an overall rating is determined. The parameters include:

Strength of intact rock (from point load or uniaxial compression tests)
Rock Quality Designation (RQD)
Spacing of Discontinuities
Condition of Discontinuities
Groundwater Effects

The strength of the intact rock was estimated from point load tests and correlations with rock fracturing during hammer blows. The RQD was estimated from in-situ bedding plane partings. The spacing and condition of discontinuities were measured in the field as well as an assessment of groundwater in the outcrops. Based on the criteria, an overall rating of 53 (fair rock) was assigned to the sandstone and a rating of 41 (poor to fair rock) was assigned to the shaley siltstone.

With the RMR rating, unit weights, and uniaxial compressive strengths, procedures recommended by Hoek and Brown (1980) were used to derive instantaneous values of cohesion and friction angle for slope stability analyses. The instantaneous cohesion and friction values are dependent on the normal stress and are plotted in Plates 3 and 4 for sandstone and shaley siltstone, respectively. For subsequent stability analyses a friction angle of 47 degrees and a cohesion value of 3600 psf (25 psi) was used for sandstone bedrock. A friction angle of 27 degrees and a cohesion value of 1700 psf (12 psi) was used for the shaley siltstone.

The properties used in the analysis are presented in the following table.

| Bedrock Type | Total Unit Weight (pcf) | Saturated Unit Weight (pcf) | Cohesion (pcf) | Friction Angle |
|---|---|---|---|---|
| Sandstone | 130 | 135 | 3600 | 43 |
| Siltstone | 125 | 130 | 1700 | 27 |

## SOIL PROPERTIES

Soil properties used in the stability analyses were generally derived from laboratory testing results. The friction angle determined for the gravelly colluvium was performed only on material finer than the No. 4 sieve. The coarser gravel, cobble, and boulder fraction is not represented, therefore, the friction angle used in the analysis was conservatively raised from 31 to 34 degrees. The friction angle of 34 degrees obtained for the silty colluvium is thought to be fairly representative of actual soil conditions. No cohesion value was used in the analysis for surficial deposits.

## ANALYSES

Slope stability analyses were performed with PCSTBL6, a two dimensional, limit equilibrium slope stability program. The analysis included both circular and irregular failure surfaces to determine the factor of safety against failure. A search routine was used that equally spaced twenty initiation points along a specified interval. From each of the initiation points generally twenty potential failure surfaces were evaluated and the failure surfaces with the minimum factors of safety identified.

Overall, six cross-sections were chosen for stability analyses. The cross-sections that were representative of steeper slopes were included. The cross-section locations are included in Plates 2A and 2B. Plates 5 through 10 include plots of the sections analyzed. Both circular and random failure surfaces were evaluated for each section. The items indicated below are included on the plots in Plates 5 through 10.

1. soil/bedrock properties used in the analysis
2. the profile modeled
3. delineation of soil and rock units
4. the configuration and location of the failure surfaces with the minimum safety factors.
5. computation of the minimum safety factors
6. search limits.

The following table summarizes the stability analysis results.

| Section Designation | Minimum Safety Factor (circular) | Minimum Safety Factor (random) |
|---|---|---|
| A-A' | 1.46 | 1.66 |
| B-B' | 5.43 | 5.3 |
| C-C' | 5.33 | 3.96 |
| D-D' | 1.72 | 3.69 |
| E-E' | 1.46 | 1.67 |
| F-F' | 7.73 | 9.59 |

## RECOMMENDATIONS

Based on our site reconnaissance, a large majority of the conveyor access road will be cut into bedrock ledges with intervening colluvium covered slopes. It is anticipated that portions of the road may require blasting where massive sandstone ledges are encountered. Since side-casting will not be allowed on steep slopes, the majority of the steeper portions of the road will be established in bedrock. Side-casting may be allowed near the bottom of drainages for road stabilization.

Where shallow deposits of colluvial material exist above the road, raveling of the colluvial deposits should be anticipated until the next ledge is encountered. However, raveling will generally be confined to material between the road and the ledge immediately above the road. A maintenance program should be anticipated since some ravel immediately above the road is expected. The material that ravels onto the road from the uphill slope should be used in the safety berm or for road stabilization.

Cuts in bedrock will generally be dependent on the joint pattern within the rock, however, vertical cuts should pose minimal stability problems. Cuts in colluvial material will be dependent on the grade of the uphill slope. Where gentle uphill slopes are encountered, cuts of two horizontal to one vertical (2H:1V) are recommended. For steeper slopes the uphill cut will depend on the overall slope. Raveling of shallow colluvial deposits between the top of the cut and the ledge immediately above the road should be anticipated where cuts exceed 2H:1V.

We anticipate that the material placed for the staging pad and portal access area will range from fine grained to boulder sized material. Due to the anticipated abundance of cobble and boulder sized fragments, monitoring of compaction will be very difficult, if possible. We recommend that compaction of the material be performed with earth-moving equipment and the following procedures be used:

1) Slopes of two horizontal to one vertical (2H:1V) be maintained in material used to construct the staging area.

2) The maximum rock size should generally be limited to 24 inches in any dimension. Larger fragments may be incorporated into the fill, provided they are isolated and assimilated into finer grained portions of fill. Alternatively, the larger fragments

may be incorporated into the upper surface of the fill or placed as a safety berm near the edges of the staging area.

3) Materials should be placed and worked to minimize void space between coarser fragments.

4) Maximum lift thicknesses for placement should be limited to 36 inches

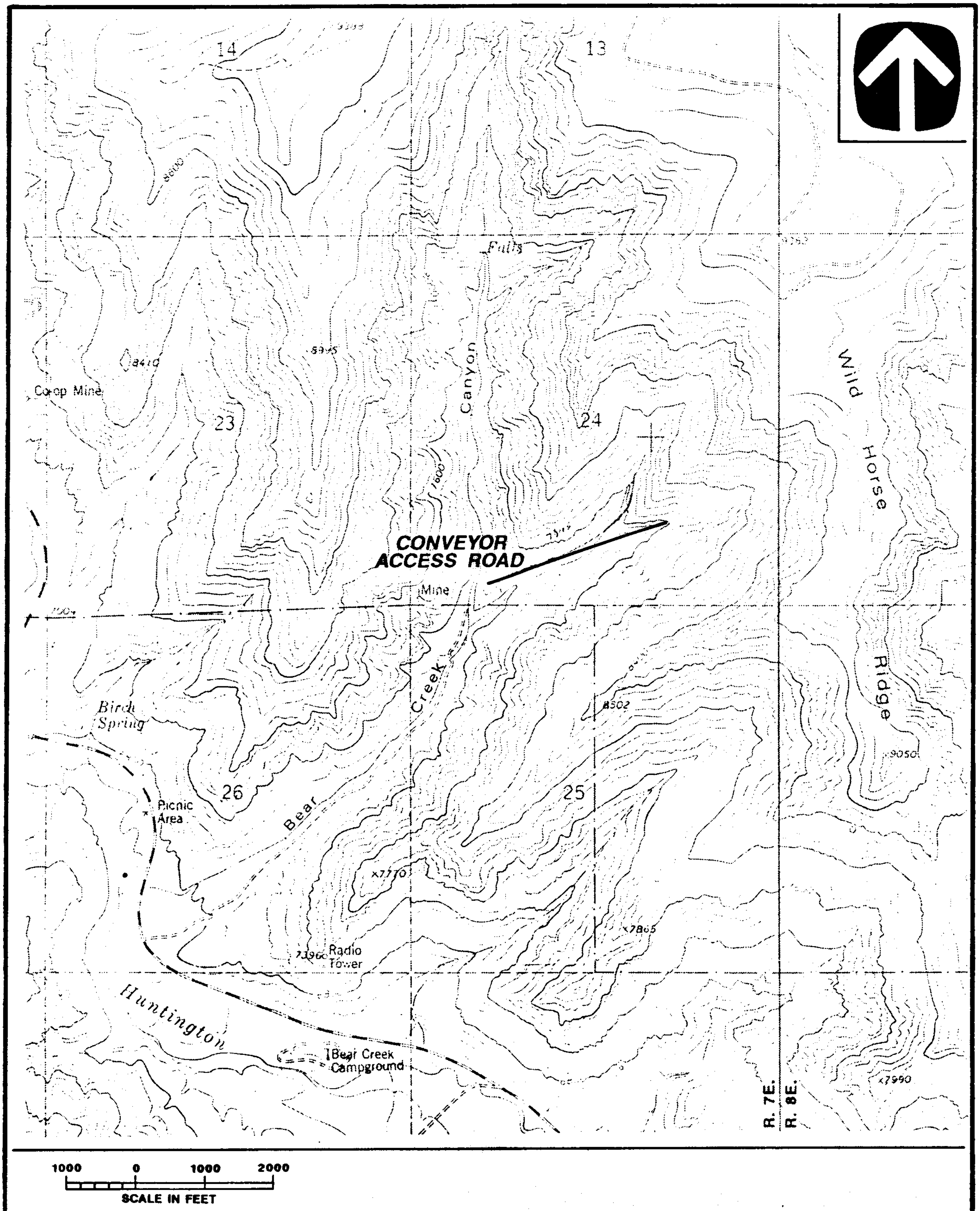
5) Adequate grubbing of vegetation should be accomplished prior to fill placement.

6) A properly sized culvert should be placed below the fill to allow for continued flow within the drainage.

## CONCLUSIONS

The majority of road cuts will be in bedrock or in bedrock overlain by shallow colluvial deposits. Vertical cuts in bedrock are expected to be stable, however, blasting should be anticipated.. Cuts in surficial deposits should be maintained at 2H:1V where gentle slopes above the road allow. Where steeper slopes are encountered, the colluvial deposits above the uphill cut should be removed as far as practical, however, raveling of this material between the road cut and first ledge above the road cut should be anticipated. A maintenance program will be required. Accumulations of material on the road due to raveling should be incorporated into a safety berm on the downhill side of the road. Adequately sized culverts will be required in the drainage to maintain flows.

oOo

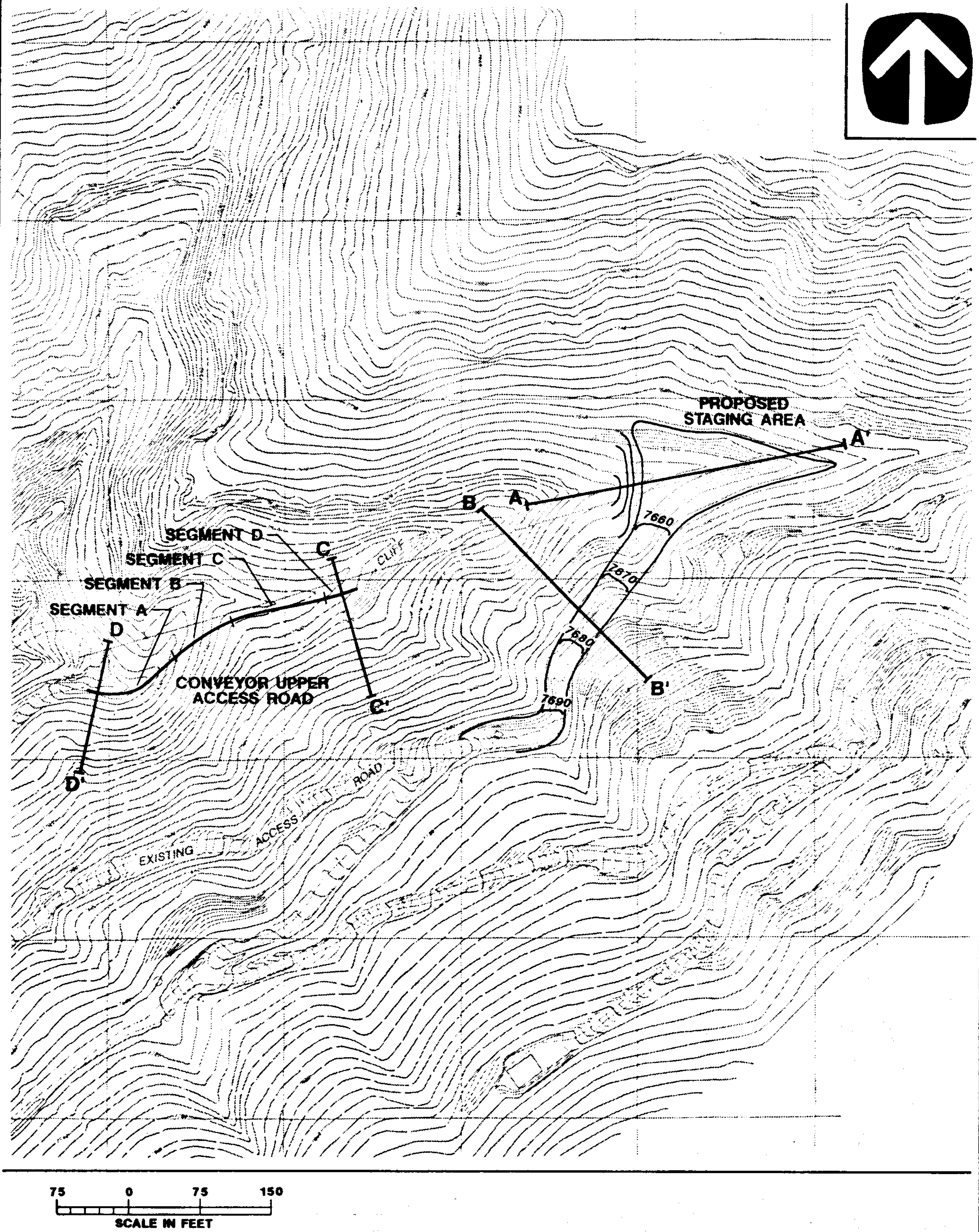



# VICINITY MAP

REFERENCE-
ADAPTED FROM U.S.G.S. TOPO MAP, "HIAWATHA, UTAH," 1978.

**Dames & Moore**

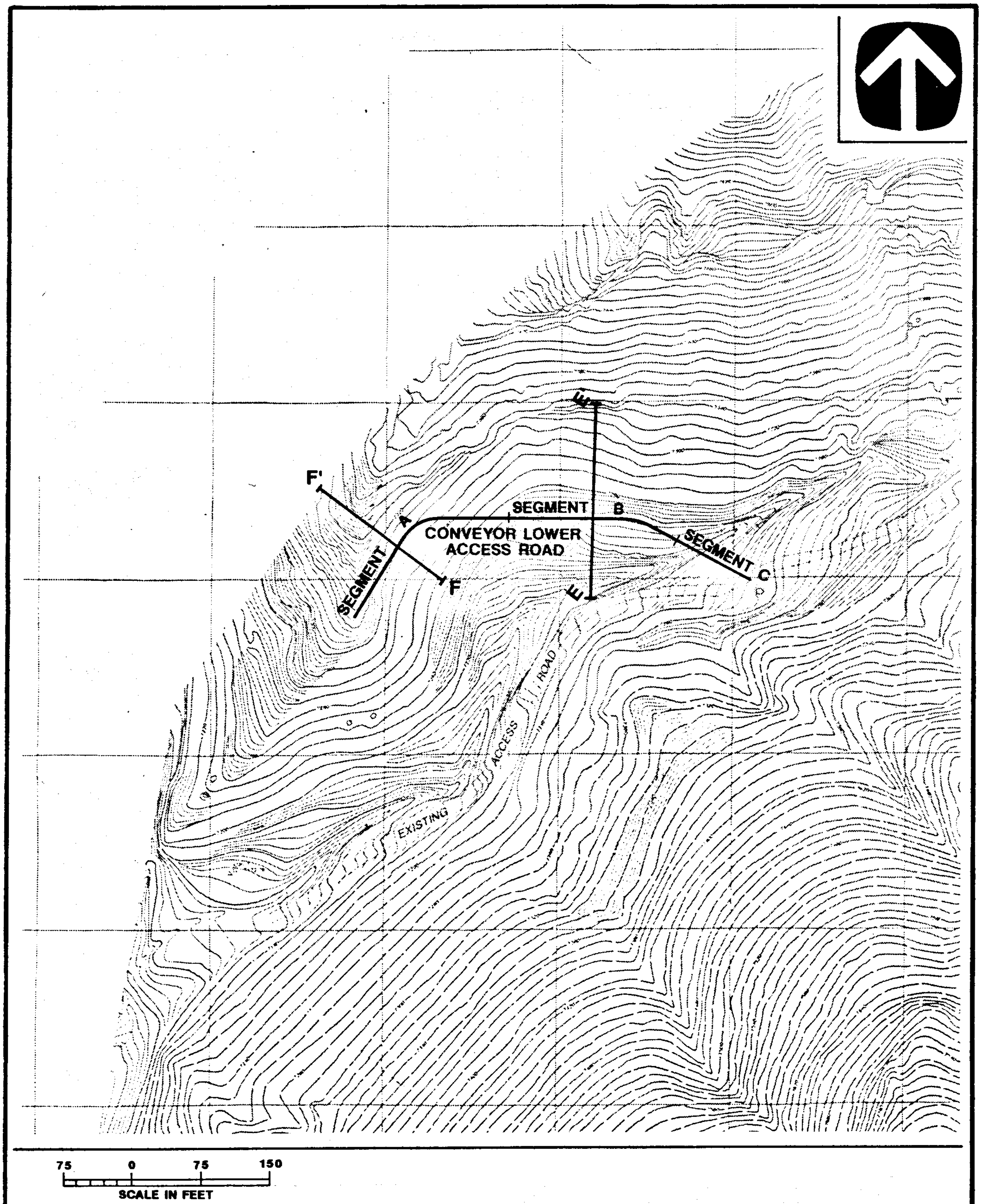
PLATE 1




# SITE PLAN
## CONVEYOR UPPER ACCESS ROAD AND STAGING AREA

REFERENCE-
ADAPTED FROM UNTITLED DRAWING
PROVIDED BY CLIENT.

Dames & Moore

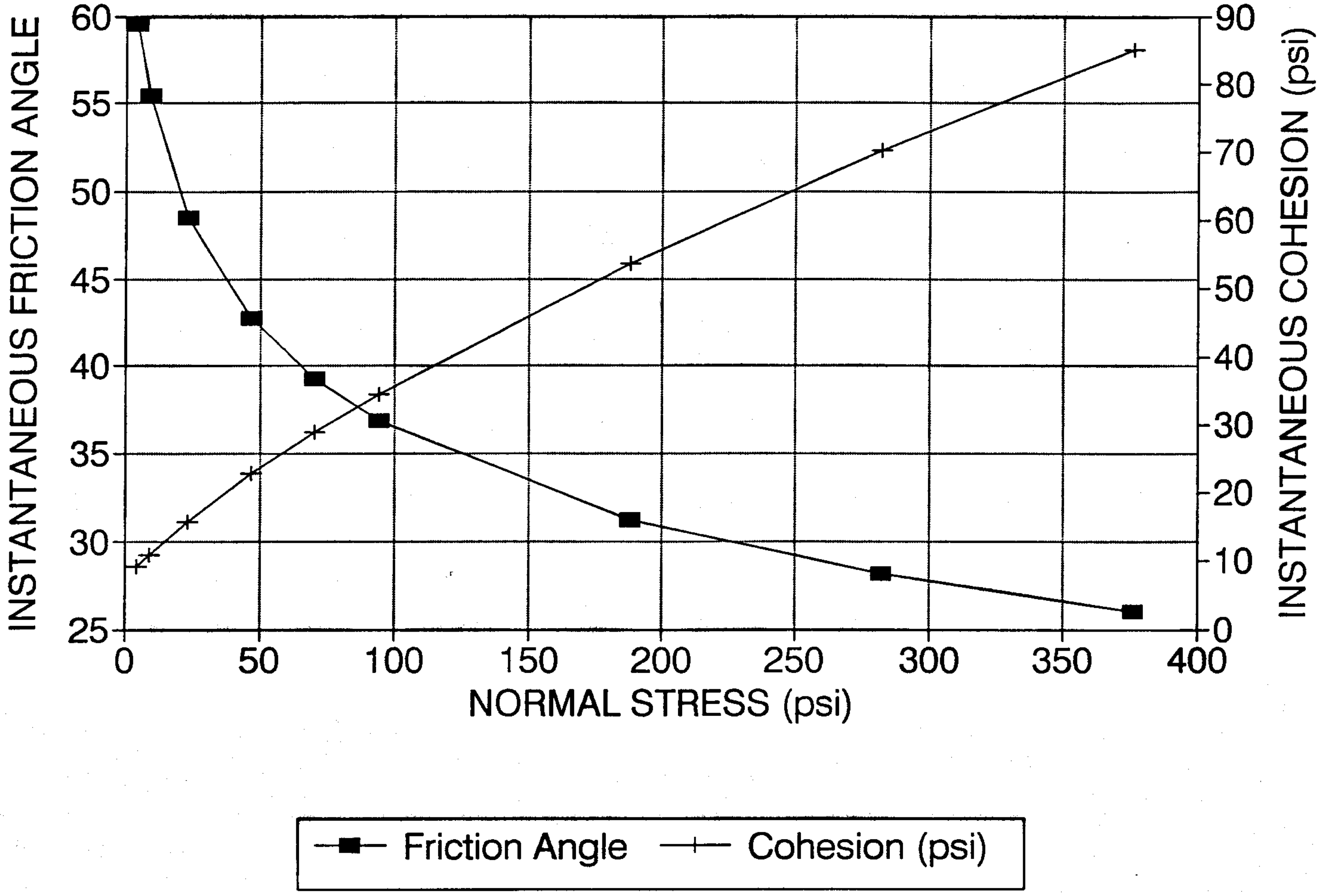



# SITE PLAN
## CONVEYOR LOWER ACCESS ROAD

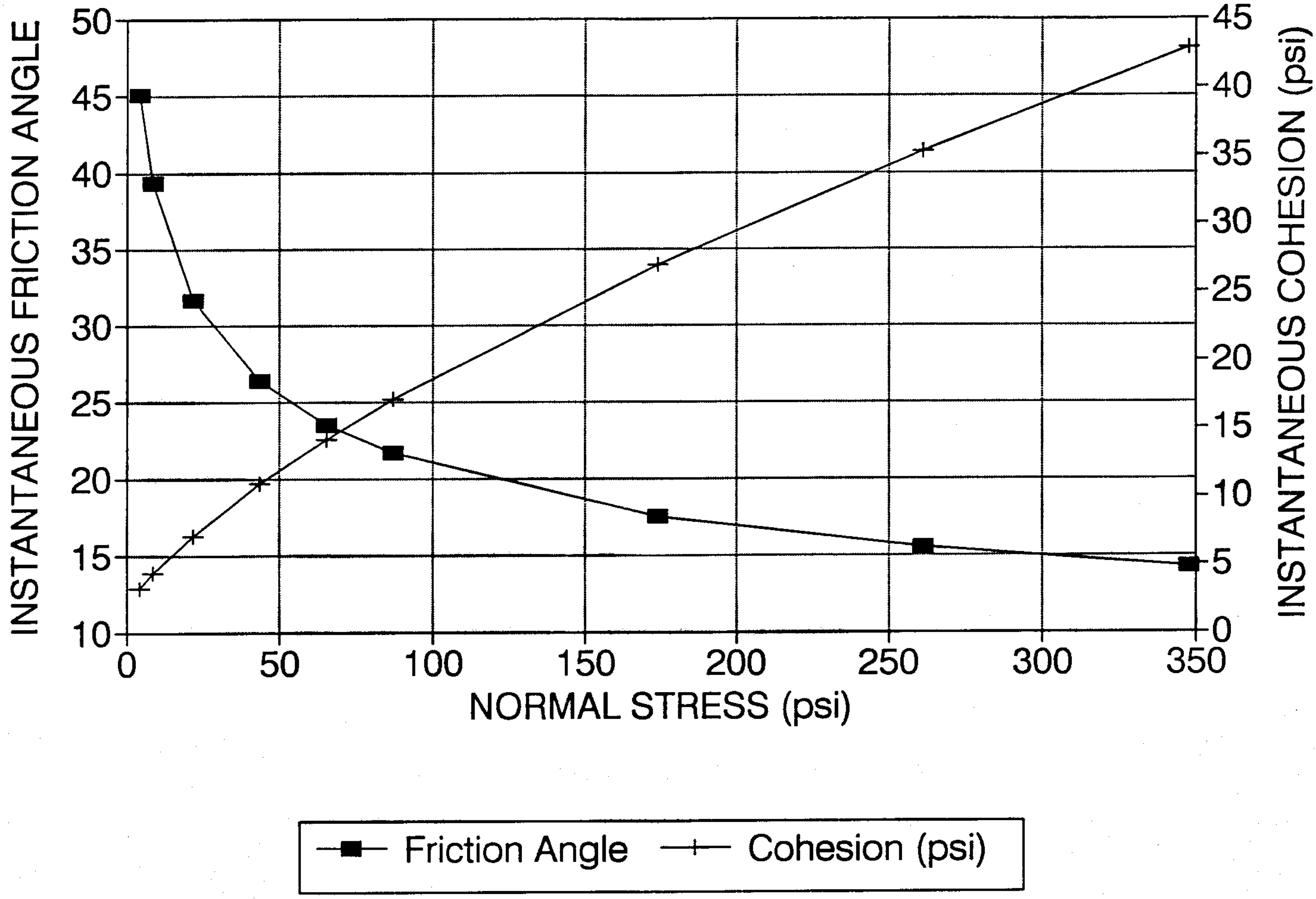
REFERENCE-
ADAPTED FROM UNTITLED DRAWING
PROVIDED BY CLIENT.

Dames & Moore

# PHI AND COHESION WITH NORMAL STRESS
## SANDSTONE (AVERAGE OF VALUES)

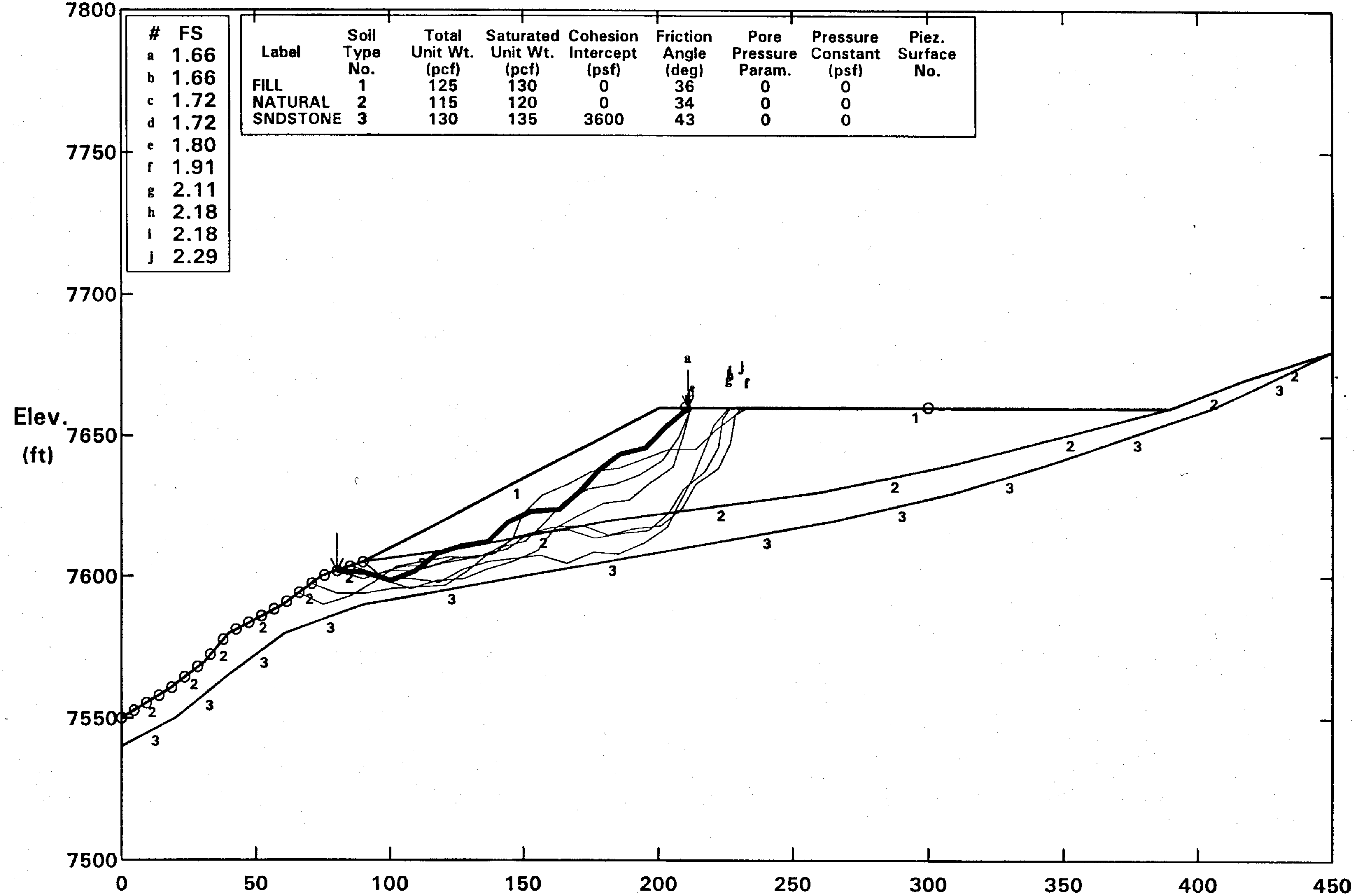


# PHI AND COHESION WITH NORMAL STRESS
## SHALEY SILTSTONE (AVERAGE OF VALUES)



# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A'

**Ten Most Critical. C:AARAN.PLT By: DAMES & MOORE 9/27/96**




| Label | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No. |
|---|---|---|---|---|---|---|---|---|
| FILL | 1 | 125 | 130 | 0 | 36 | 0 | 0 | |
| NATURAL | 2 | 115 | 120 | 0 | 34 | 0 | 0 | |
| SNDSTONE | 3 | 130 | 135 | 3600 | 43 | 0 | 0 | |

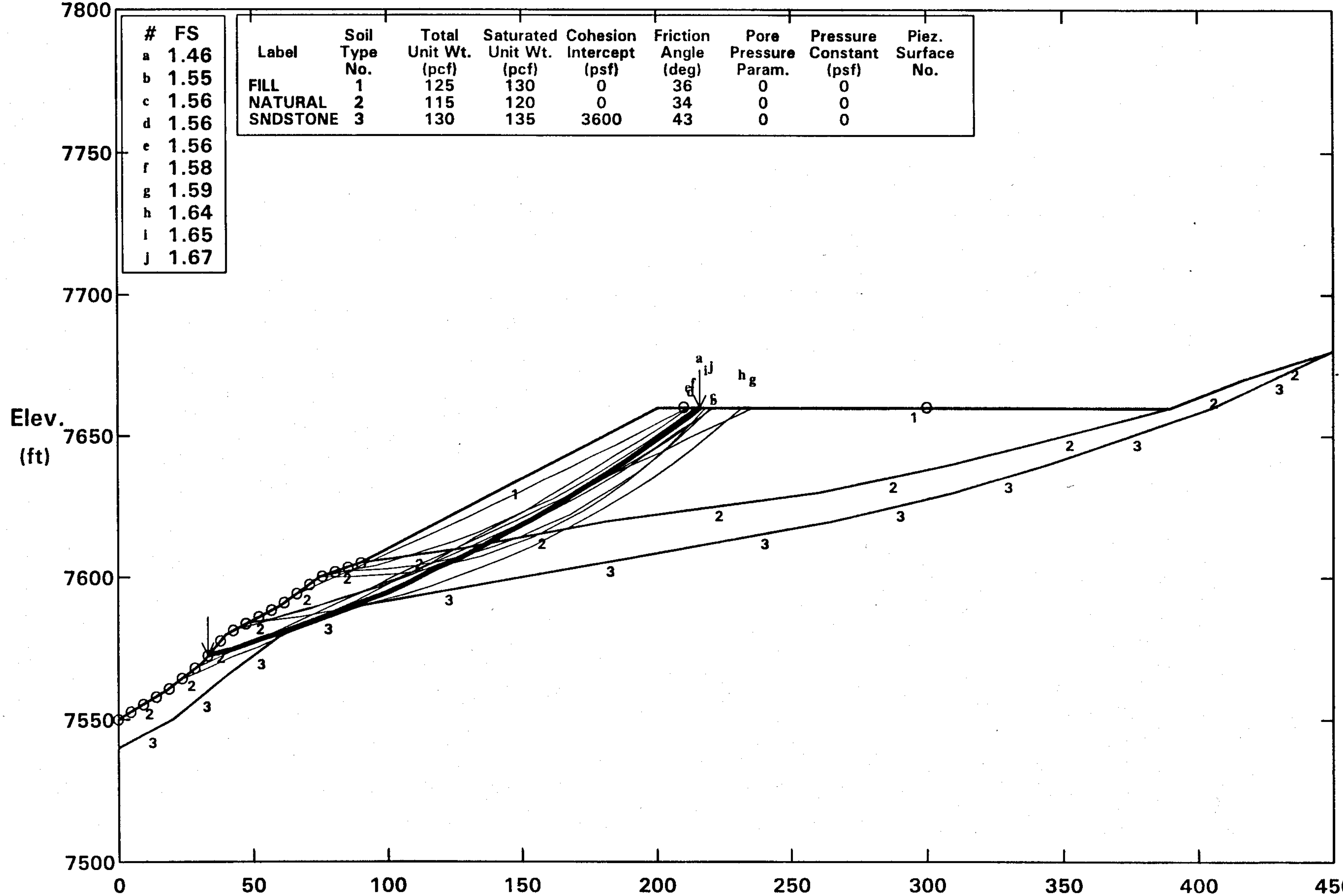
STABL6H FSmin = 1.66 X-Axis (ft)

Factors Of Safety Calculated By The Modified Janbu Method

PLATE 5A

# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A'

Ten Most Critical. C:AA.PLT By: Dames & Moore 09-27-96 3:25pm



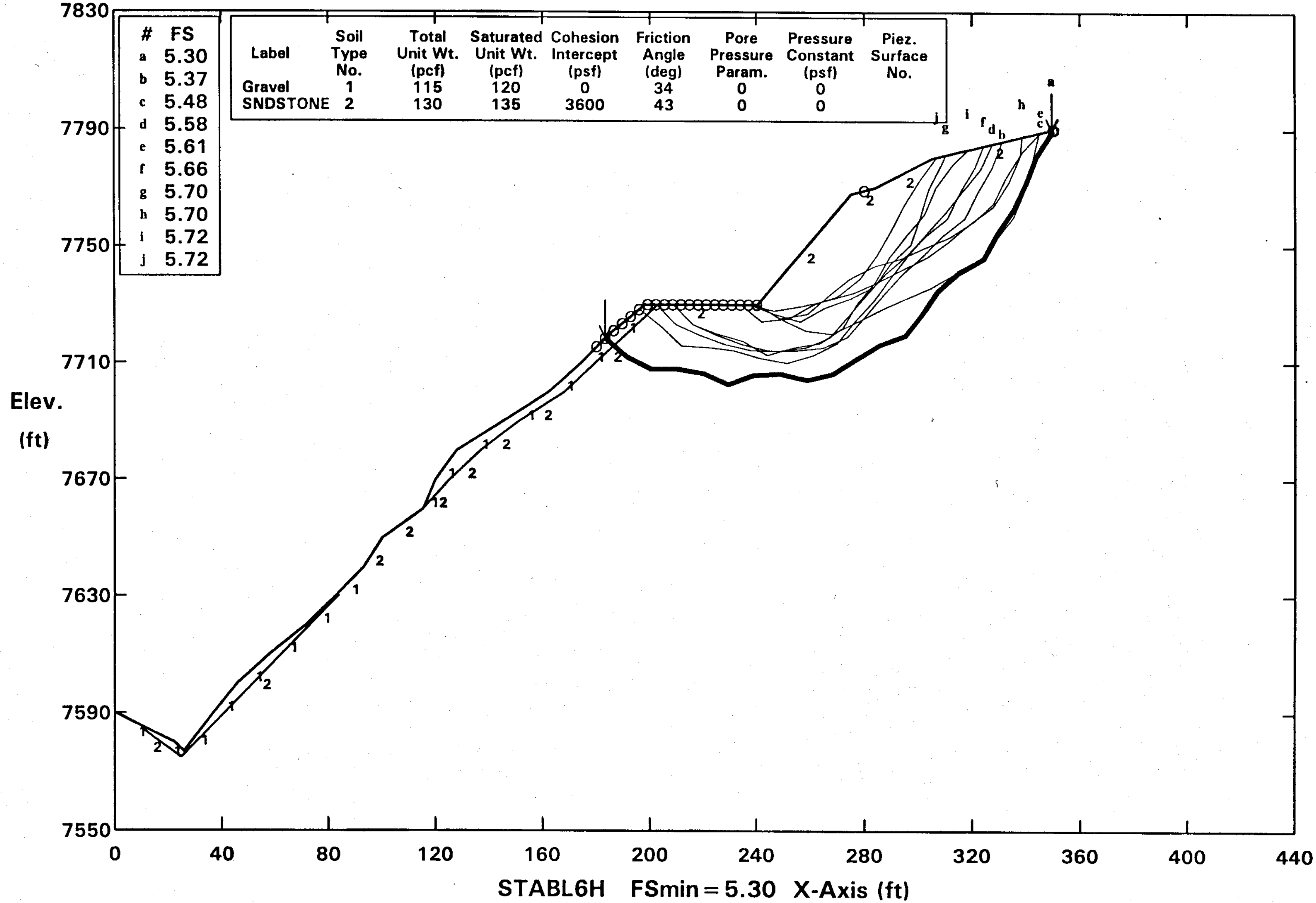

STABL6H FSmin = 1.46 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

PLATE 5B

## Portal Staging Area Access Section B-B'

Ten Most Critical. C:BBRAN.PLT By: DAMES & MOORE 9/27/96

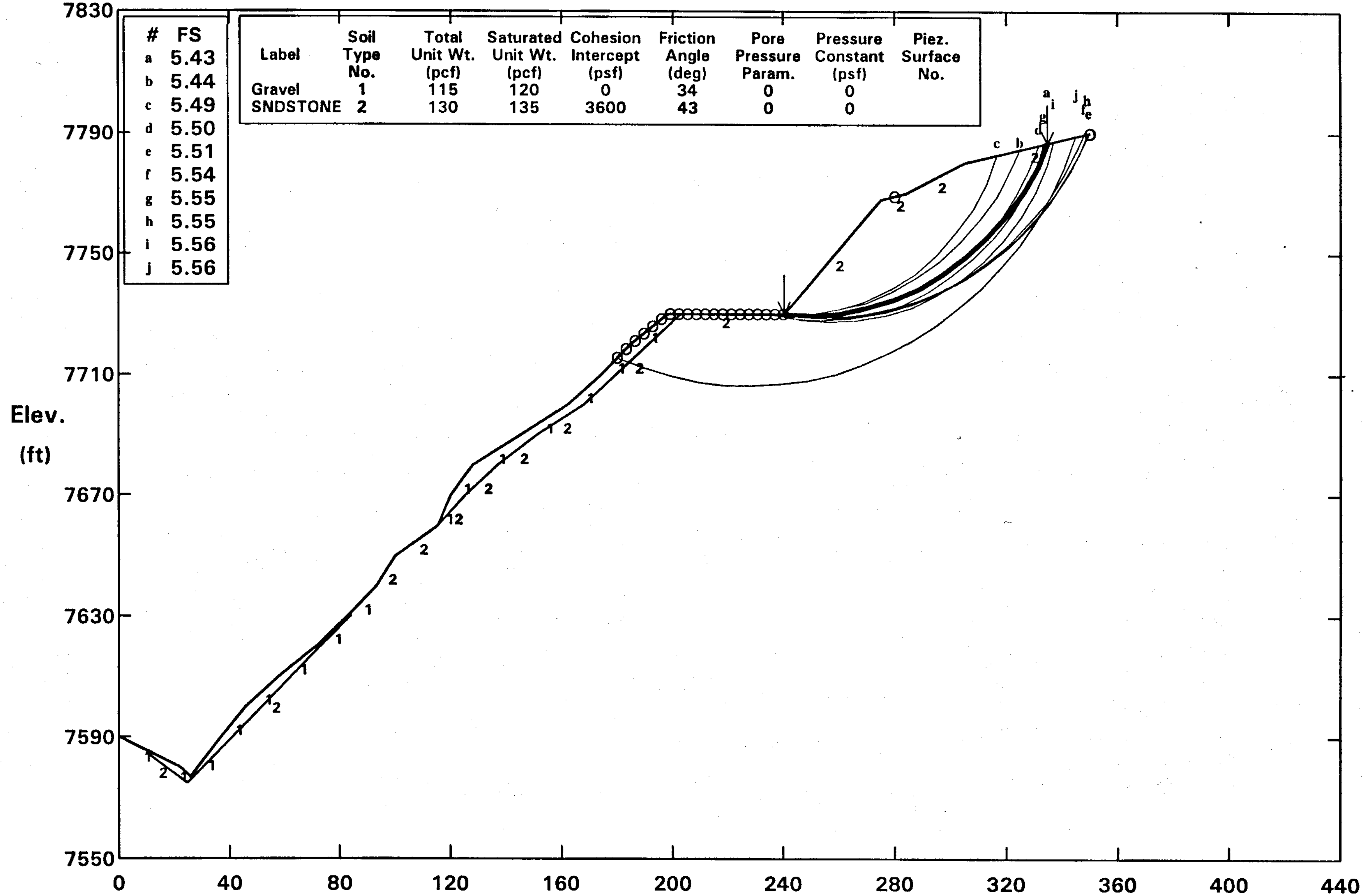



Factors Of Safety Calculated By The Modified Janbu Method

PLATE 6A

# Portal Staging Area Access Section B-B'

Ten Most Critical. C:BB.PLT By: Dames & Moore 09-27-96 3:35pm



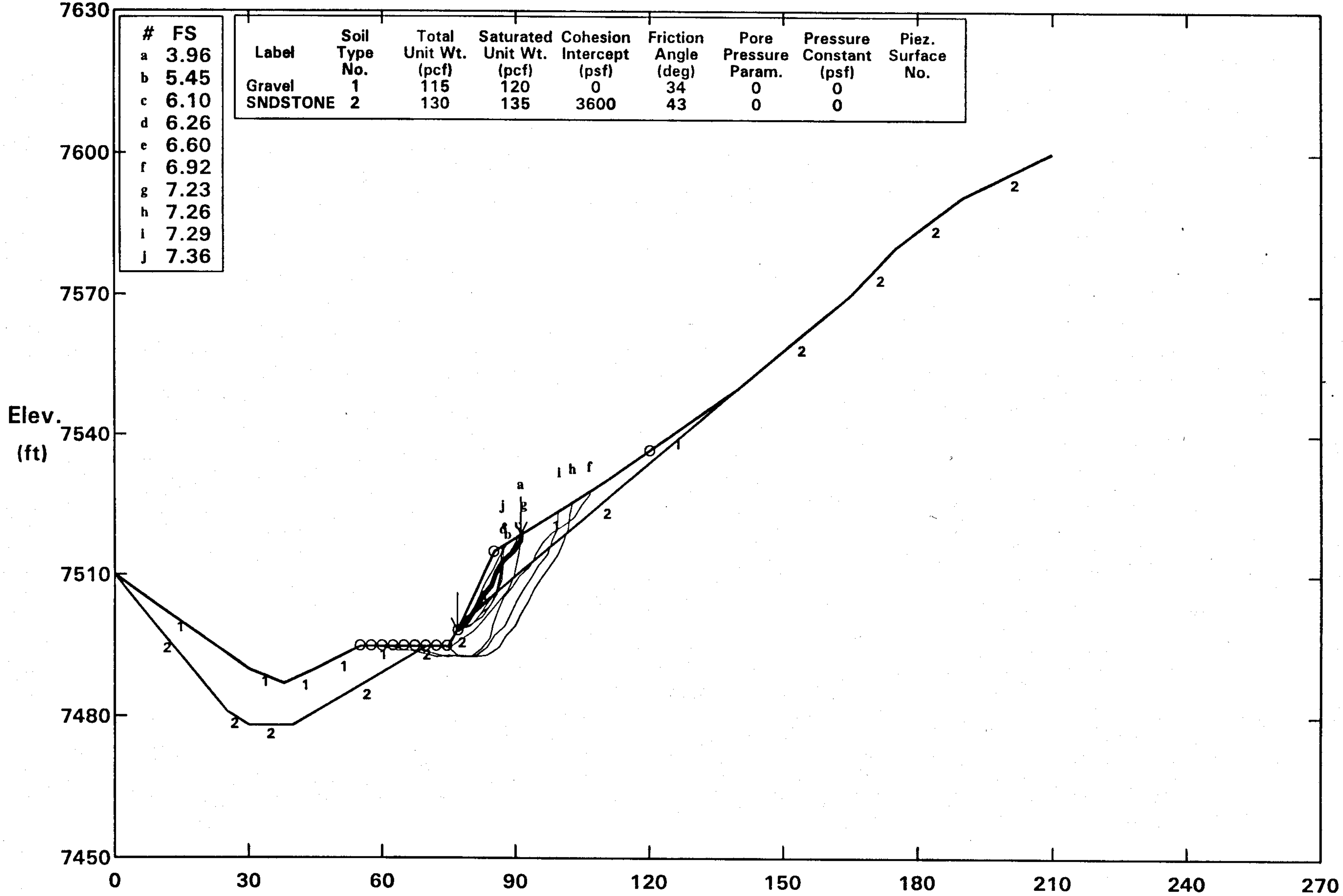

STABL6H FSmin = 5.43 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

PLATE 6B

## CONVEYOR UPPER ACCESS ROAD Section C-C'

Ten Most Critical. C:CCRAN.PLT By: Dames & Moore 09-27-96 4:24pm



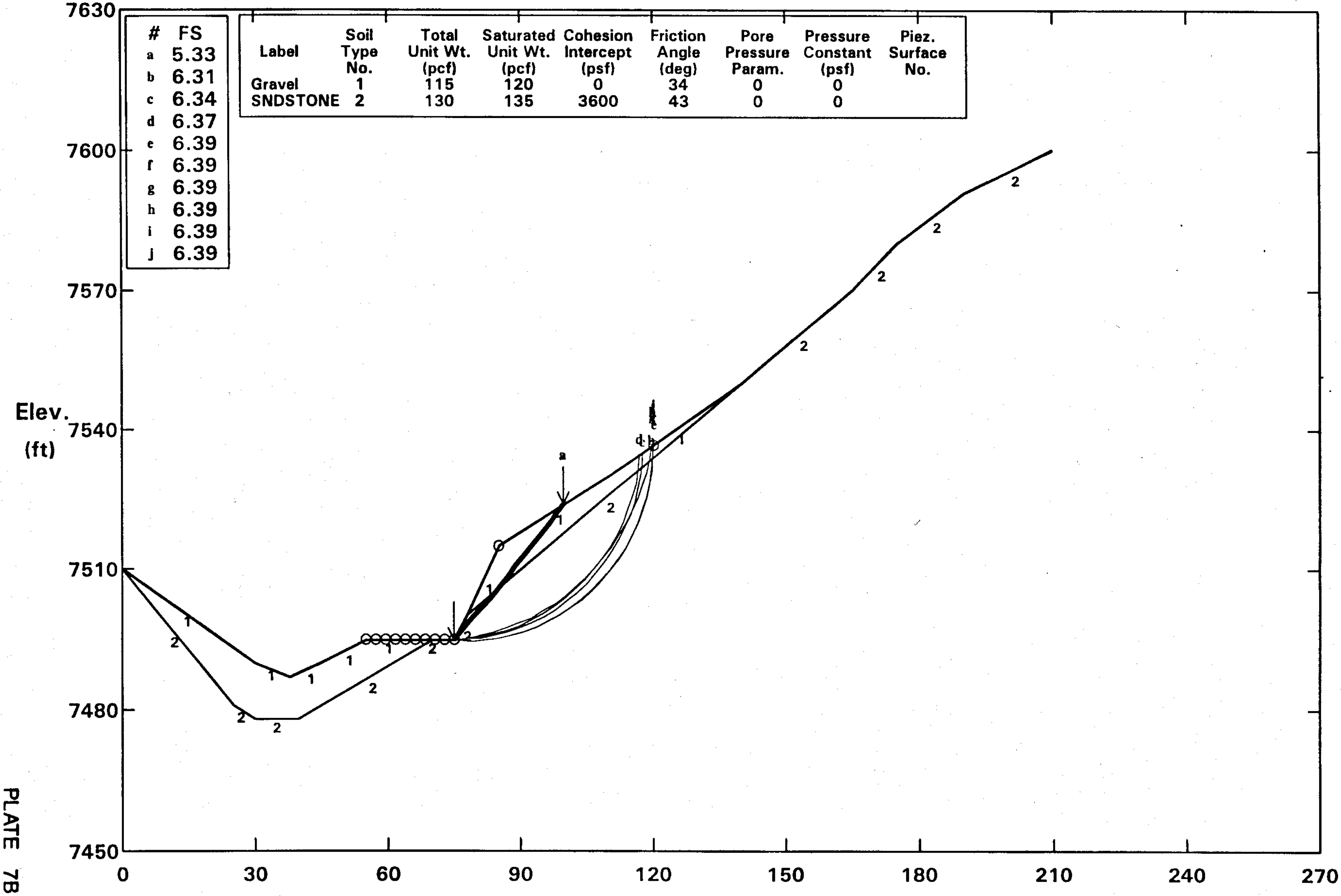

STABL6H FSmin = 3.96 X-Axis (ft)

Factors Of Safety Calculated By The Modified Janbu Method

PLATE 7A

# CONVEYOR UPPER ACCESS ROAD Section C-C'

**Ten Most Critical. C:CC.PLT By: Dames & Moore 09-27-96 4:19pm**



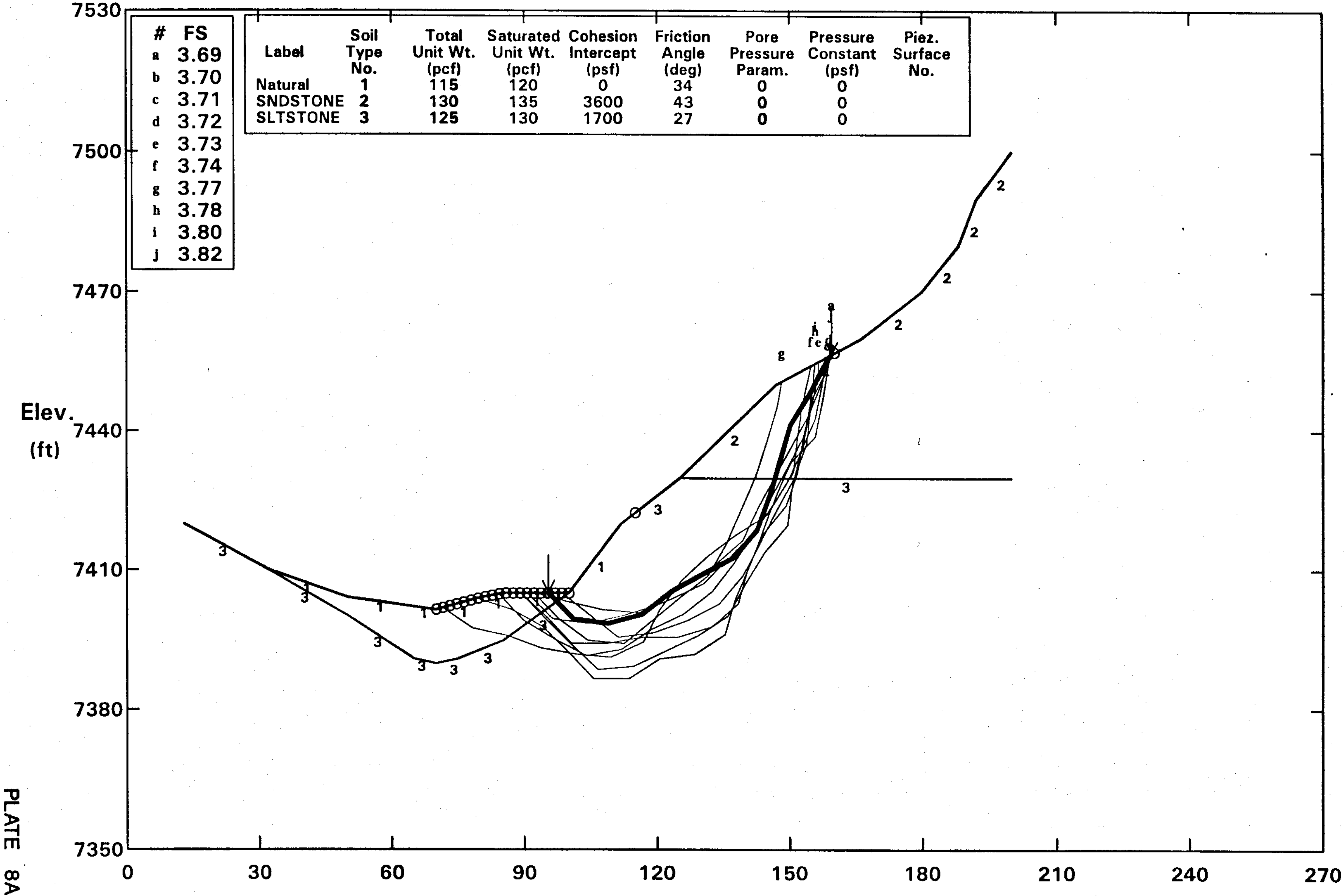

**STABL6H FSmin = 5.33 X-Axis (ft)**

**Factors Of Safety Calculated By The Modified Bishop Method**

PLATE 7B

# CONVEYOR UPPER ACCESS ROAD Section D-D'

**Ten Most Critical. C:DDRAN.PLT By: Dames & Moore 09-27-96 4:42pm**



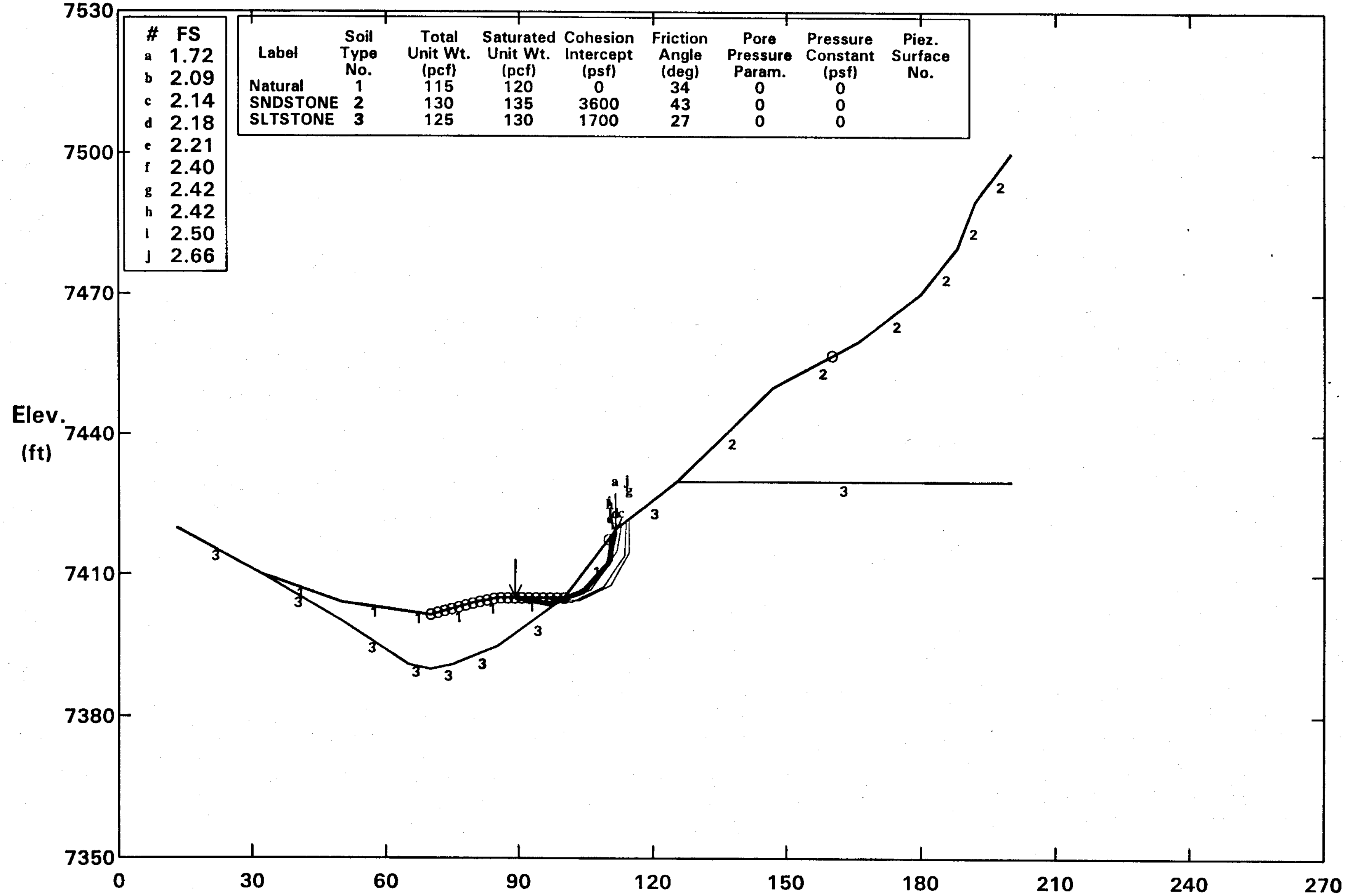

STABL6H FSmin = 3.69 X-Axis (ft)

Factors Of Safety Calculated By The Modified Janbu Method

PLATE 8A

# CONVEYOR UPPER ACCESS ROAD Section D-D'

Ten Most Critical. C:DD.PLT By: Dames & Moore 09-27-96 4:40pm



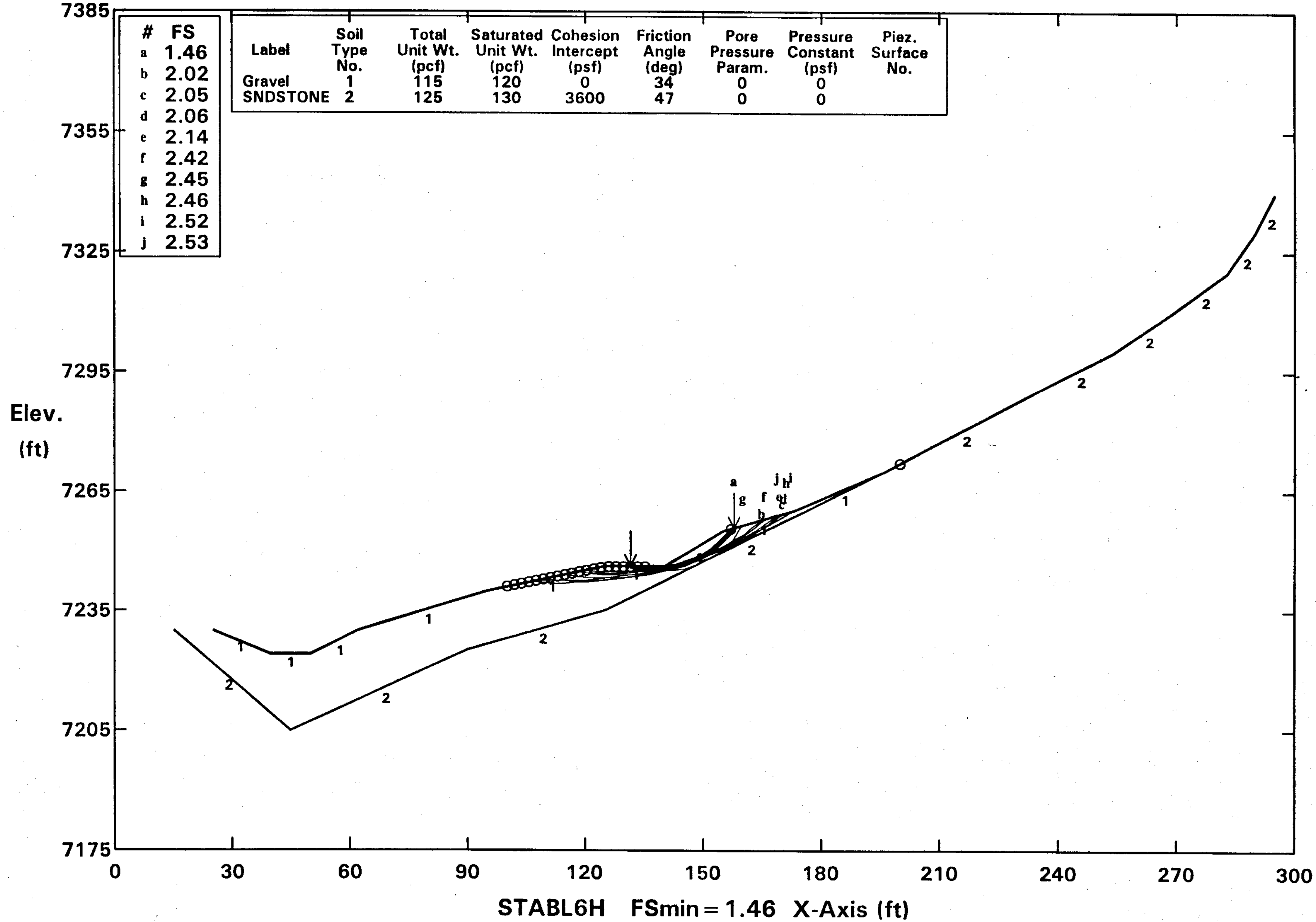

STABL6H FSmin = 1.72 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

PLATE 8B

# CONVEYOR LOWER ACCESS ROAD Section E-E'

Ten Most Critical. C:EE.PLT By: Dames & Moore 09-27-96 4:48pm

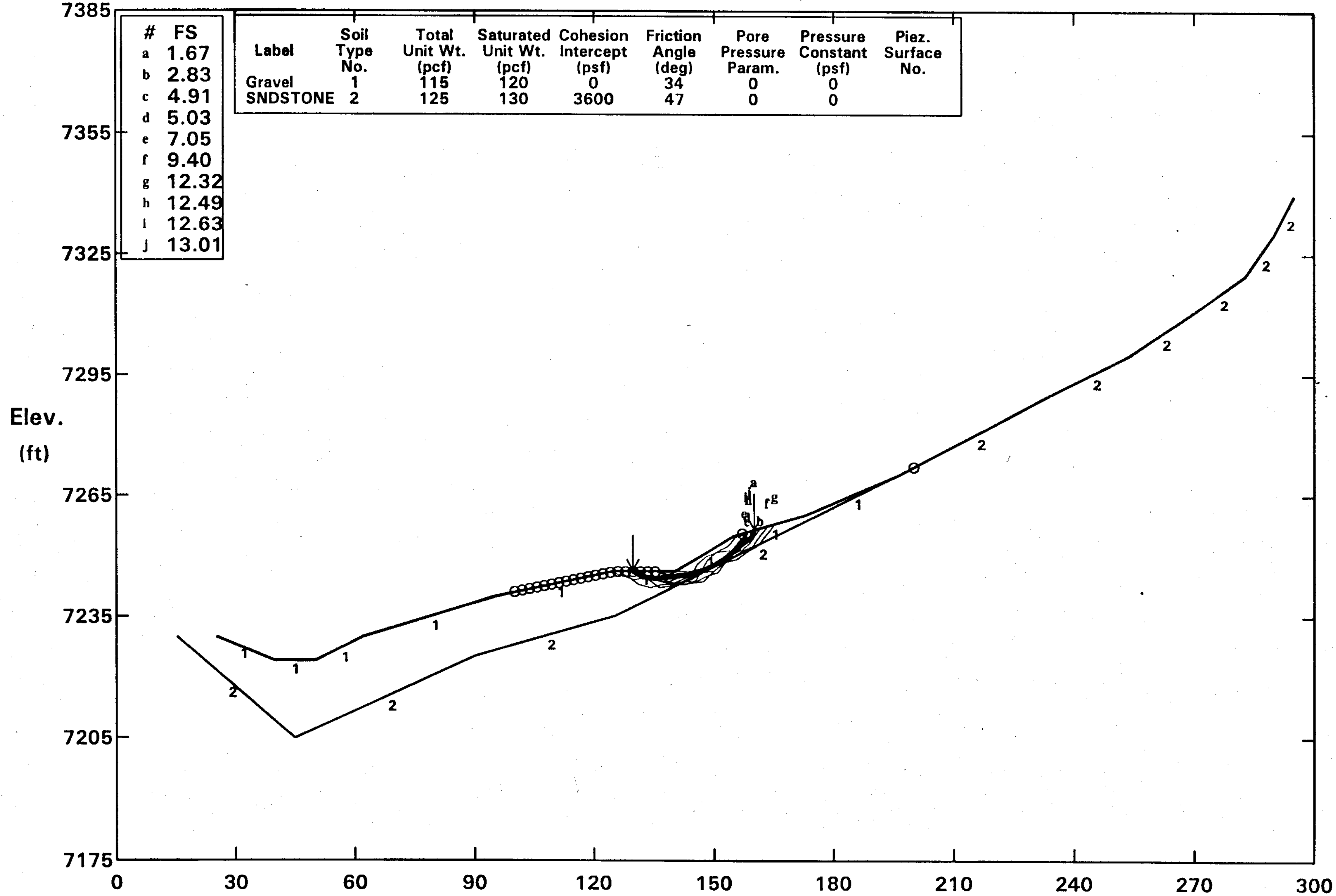



Factors Of Safety Calculated By The Modified Bishop Method

PLATE 9A

## CONVEYOR LOWER ACCESS ROAD Section E-E'

Ten Most Critical. C:EERAN.PLT By: Dames & Moore 09-27-96 4:48pm



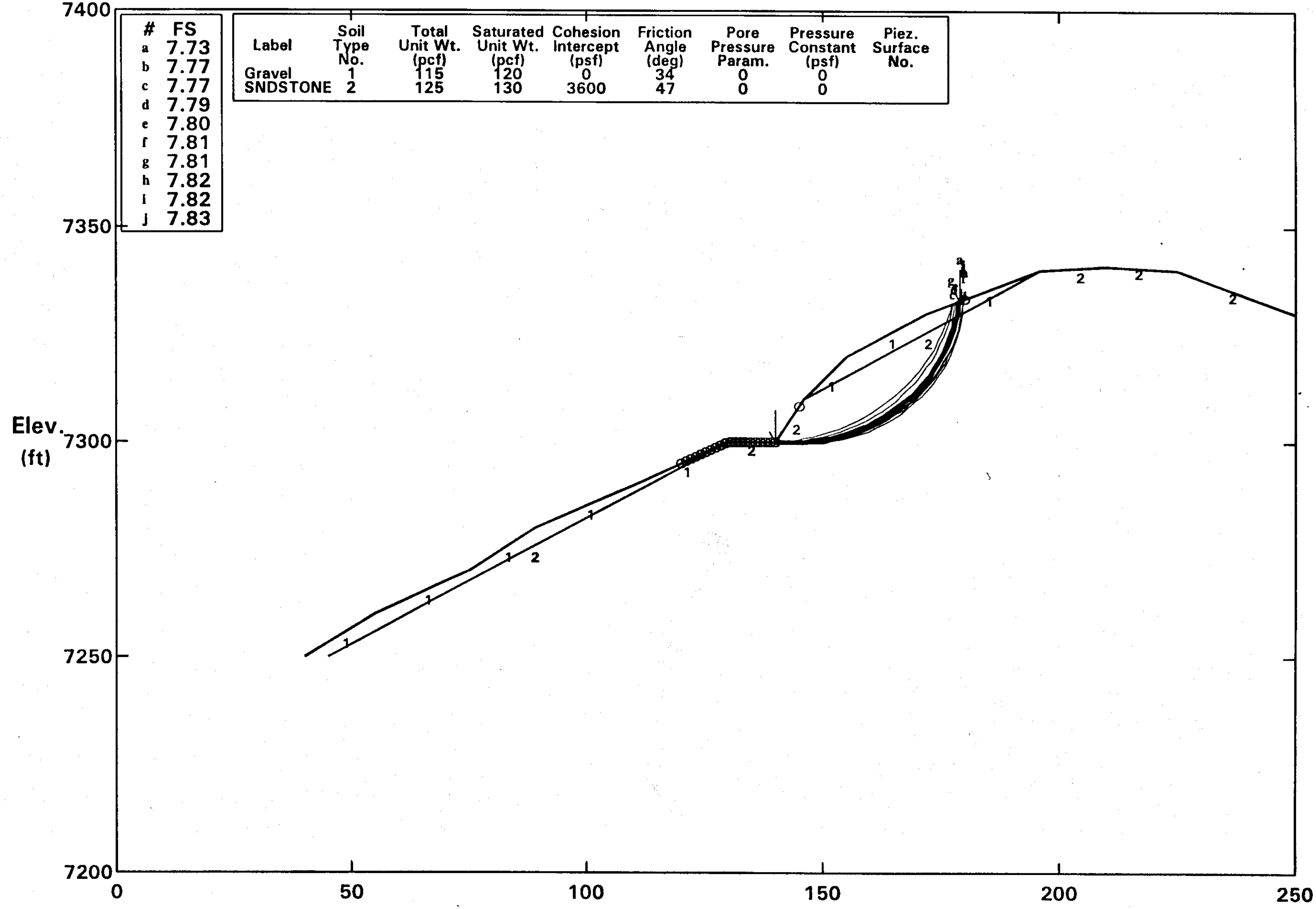

STABL6H FSmin = 1.67 X-Axis (ft)

Factors Of Safety Calculated By The Modified Janbu Method

PLATE 9B

## CONVEYOR LOWER ACCESS ROAD Section F-F'

Ten Most Critical. C:FF.PLT By: Dames & Moore 09-27-96 4:55pm



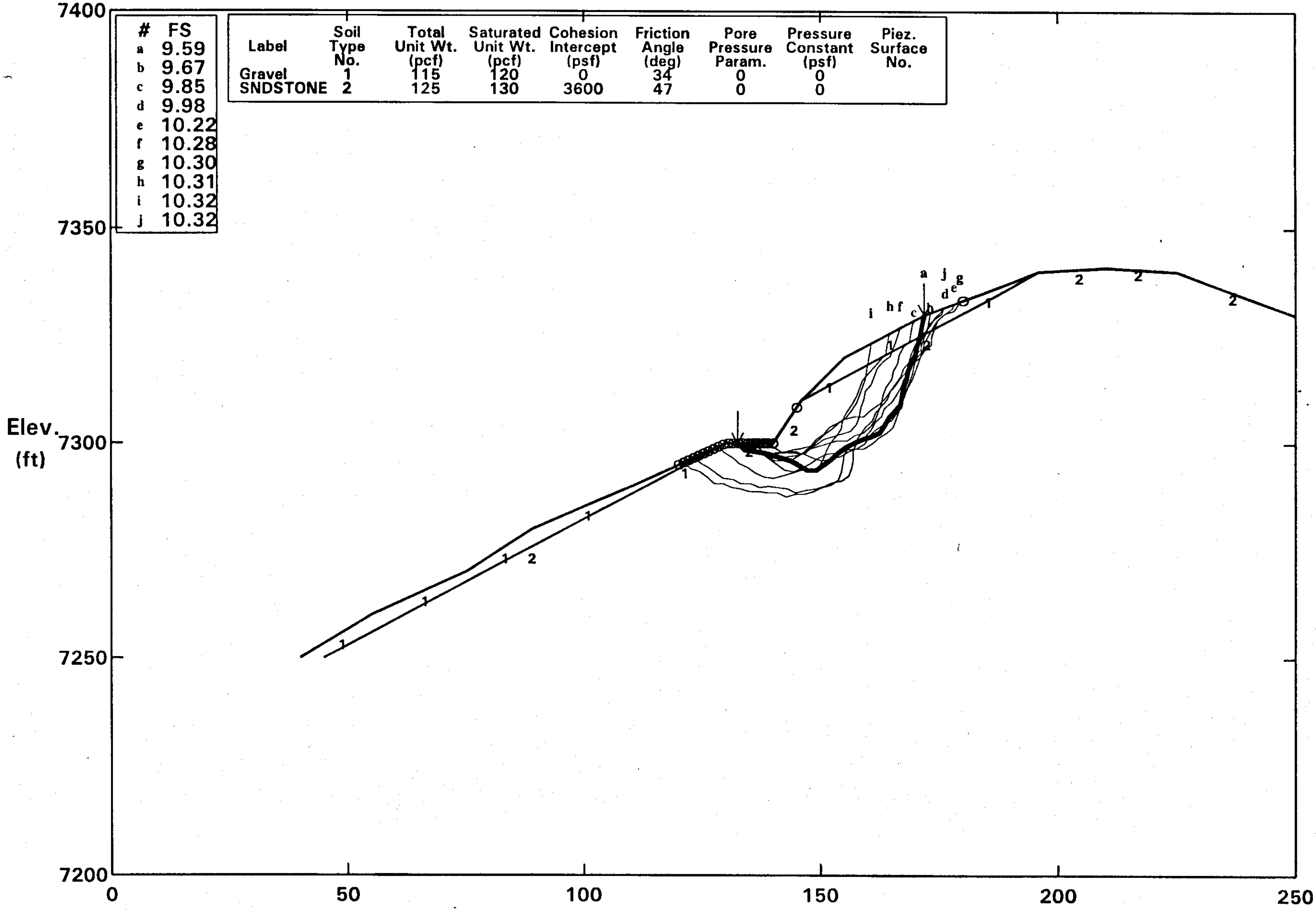

STABL6H FSmin = 7.73 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

PLATE 10A

# CONVEYOR LOWER ACCESS ROAD Section F-F'

Ten Most Critical. C:FFRAN.PLT By: Dames & Moore 09-27-96 4:55pm




STABL6H FSmin = 9.59 X-Axis (ft)

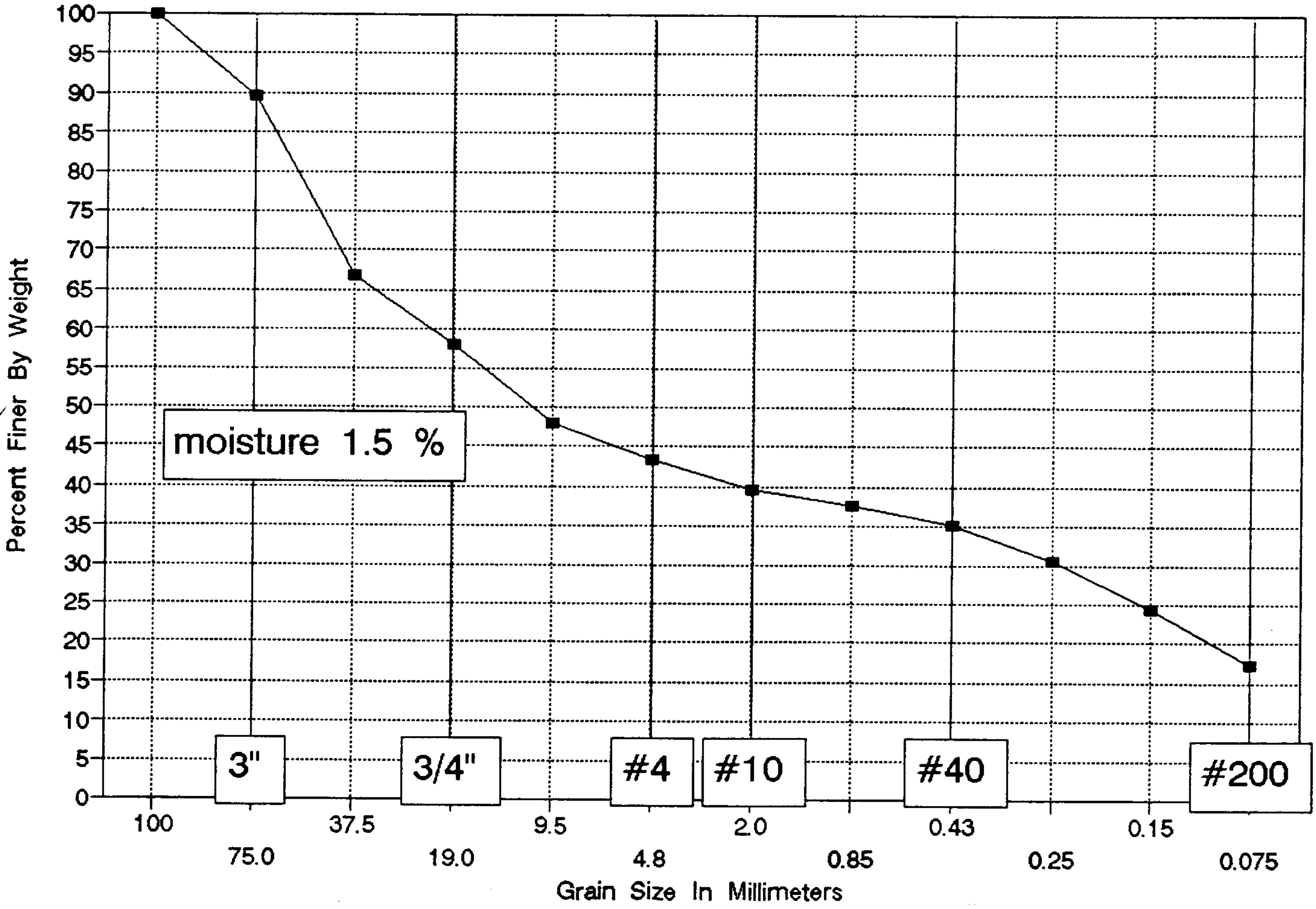
Factors Of Safety Calculated By The Modified Janbu Method

PLATE 10B

# Appendix

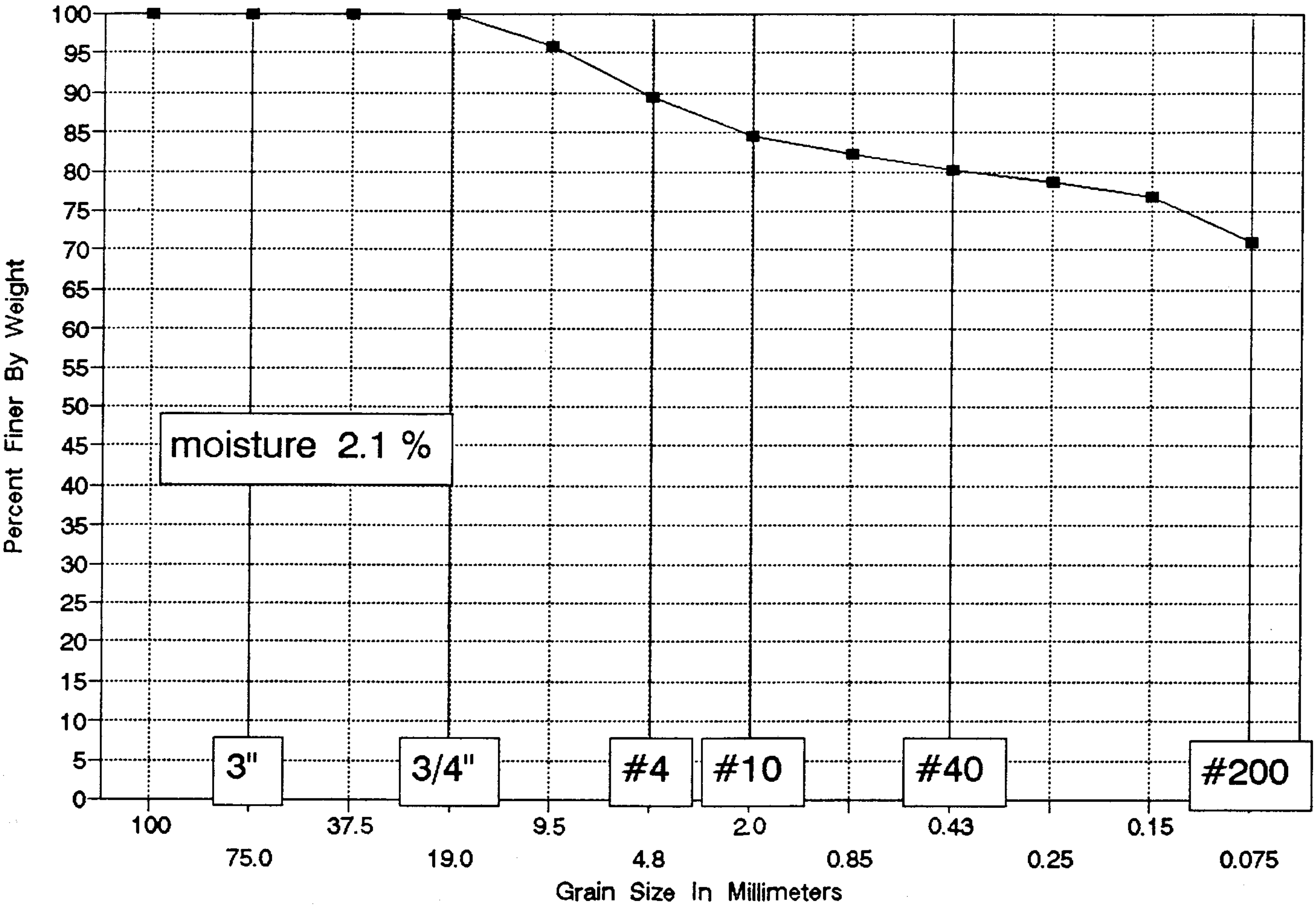
# GRADATION CURVE

CO-OP Mine, Bulk Sample TP-1



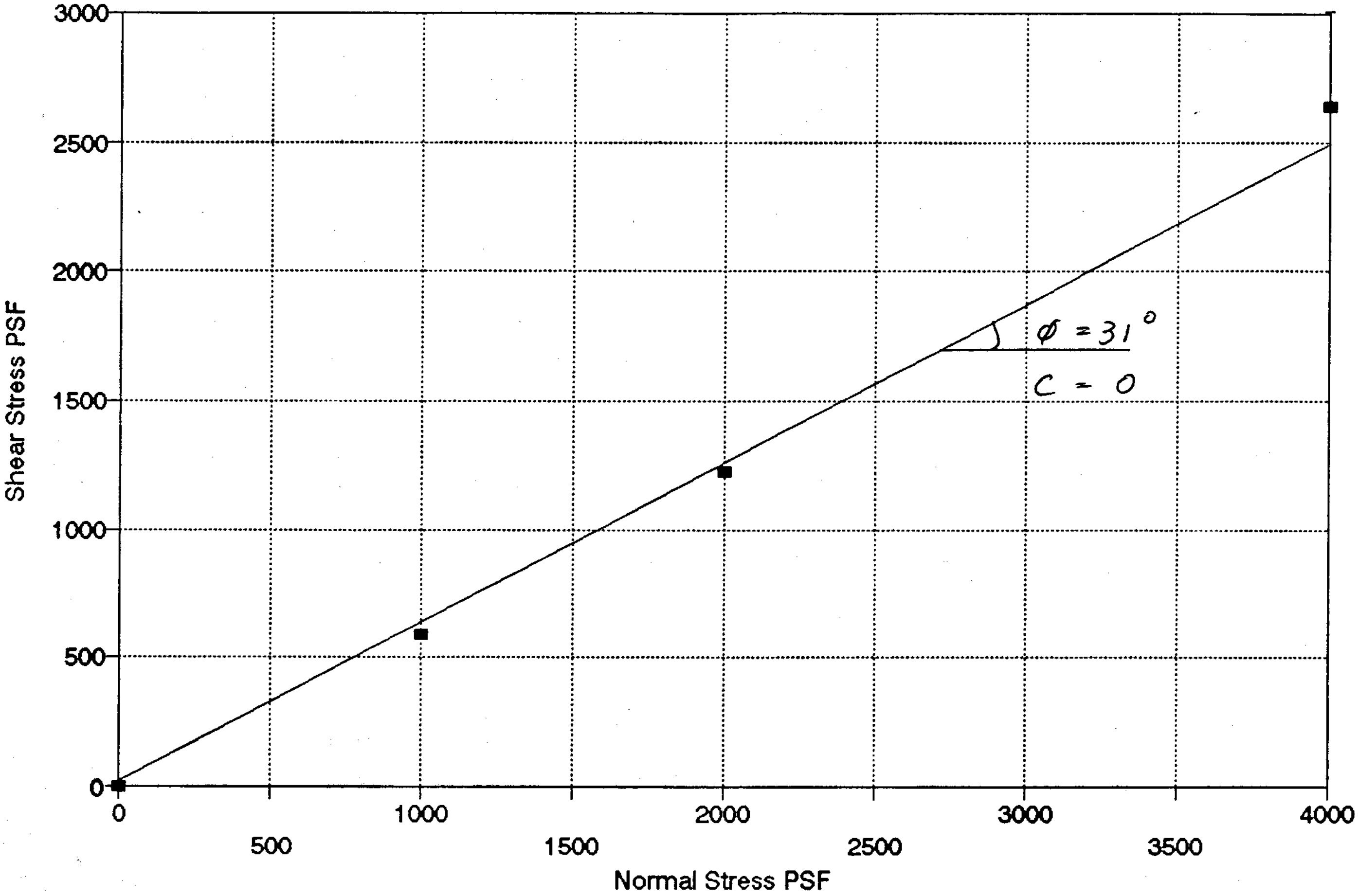
# GRADATION CURVE

CO-OP Mine, Bulk Sample TP-2



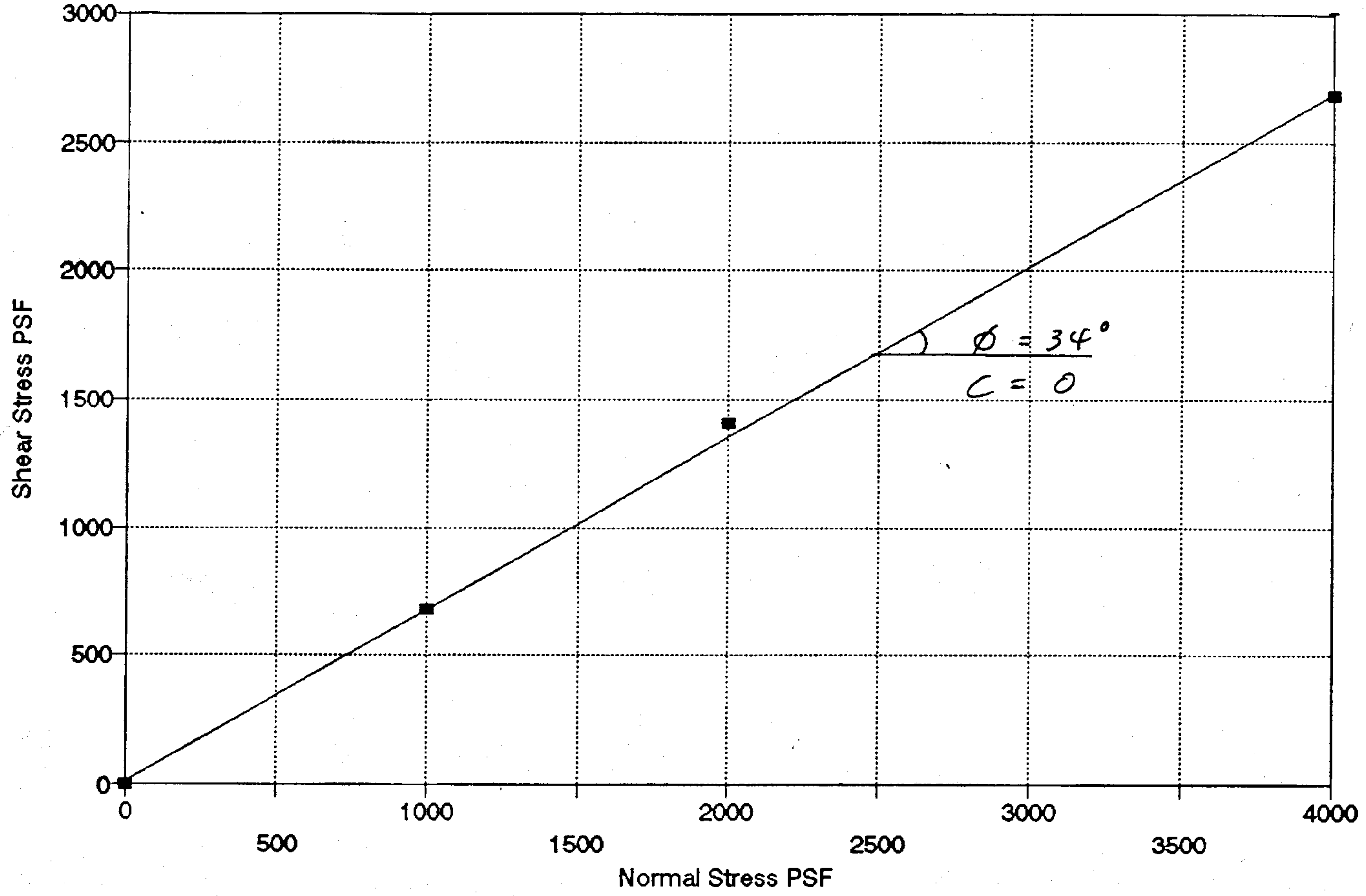
# DIRECT SHEAR - Consolidated Undrained

CO-OP Mine, Remold sample TP-1



# DIRECT SHEAR - Consolidated Undrained

CO-OP Mine, Remold sample TP-2



DAMES & MOORE
A DAMES & MOORE GROUP COMPANY

127 South 500 East, Suite 300
Salt Lake City, Utah 84102-1959
801 521 9255 Tel
801 521 0380 Fax
800 432 6375 Tel

July 23, 1999

CO-OP Mining Company
P. O. Box 1245
Huntington Canyon
Huntington, Utah 84528

Attention: Mr. Charles Reynolds

RE: Slope Stability Evaluation
Portal Staging Area
Wild Horse Ridge, Bear Canyon No. 3
Huntington Canyon

Dear Mr. Reynolds:

This letter presents the results of a reevaluation of the stability of the fill slope at the Portal Staging Area, with the addition of a 7-foot deep sedimentation pond. It is understood that the pond will be located near the easternmost edge of the structural fill comprising the Portal Staging Area. The pond geometry used in the analyses was based on a sketch provided by your office on July 8, 1999. The analyses were performed in accordance with our proposal dated July 13, 1999.

The soil and rock parameters used in the stability analyses are based on those selected as part of our original geotechnical evaluation of the Portal Staging Area (see Slope Stability Evaluation Report, dated October 7, 1996). The properties used in the analyses to model the soil and rock are presented in the following table.

| Soil/Bedrock Type | Total Unit Weight (pcf) | Saturated Unit Weight (pcf) | Cohesion (psf) | Angle of Internal Friction (degrees) |
|---|---|---|---|---|
| Compacted Structural Fill | 125 | 130 | 0 | 36 |
| Native Granular Colluvium | 115 | 120 | 0 | 34 |
| Native Sandstone | 130 | 135 | 3,600 | 43 |

To model the effects of the proposed sedimentation pond on the stability of the staging area slopes, 1) a full pond condition was assumed, and 2) two distinct steady-state seepage conditions were assumed. The first seepage condition is based on a straight-line phreatic surface within the structural fill and native materials resulting from infiltration of the impounded water. The second seepage condition is based on a phreatic surface that follows the interface between the native sandstone and the overlying granular colluvium.

The slope stability analyses were performed with PCSTABL6, which uses two-dimensional, limit equilibrium as a computational basis. The analyses included circular failure surfaces to determine the factor of safety against slope failure. A search routine was used that equally spaced 30 initiation points along a specified slope length. From each of the initiation points 30 trail failure surfaces were generated. A factor of safety was computed for each trail failure surface to aid identification of the minimum factor of safety. The results of the slope stability analyses are attached.

As shown on the attached results, factors of safety against slope failure ranging from 1.44 to greater than 2 were computed for static conditions, a full sedimentation pond, and the two steady-state seepage conditions. The analyses resulted in computed factors of safety greater than about 1.1 for a pseudo-static/earthquake loading of 0.20g (peak horizontal acceleration), and failure conditions constrained to relatively deep slope failure surfaces. By way of comparison, a minimum factor of safety of approximately 0.90 was computed for shallow slope failures (generally characterized by surface slumps and sloughing) and a pseudo-static/earthquake loading of 0.20g.

To account for localized variations and uncertainties associated with the type and strength of the structural fill and native earth materials, factors of safety ranging from 1.3 to 1.5 or greater are considered adequate to represent safe conditions for static loads and steady-state seepage conditions. A factor of safety of 1.1 or greater is commonly used to represent safe conditions for earthquake loads.

In general, the conditions analyzed and the attached results demonstrate computed factors of safety equal to or greater than those considered adequate for safe long-term performance. The primary exception to this conclusion is the condition of shallow slope failures resulting from strong ground motion. It is noted that the presence of the sedimentation pond (or seepage from the pond) does not effect the relatively low computed factors of safety for this condition. In addition, adequate factors of safety were computed against slope failure for relatively deep failure surfaces.

Based on the results of our analyses for seepage and earthquake (pseudo-static) loading conditions, it appears unlikely that the pond would be in jeopardy as result of strong ground motion. However, shallow surface slides and sloughing of the exposed structural fill and native soil slopes should be expected as a result of strong ground motion.

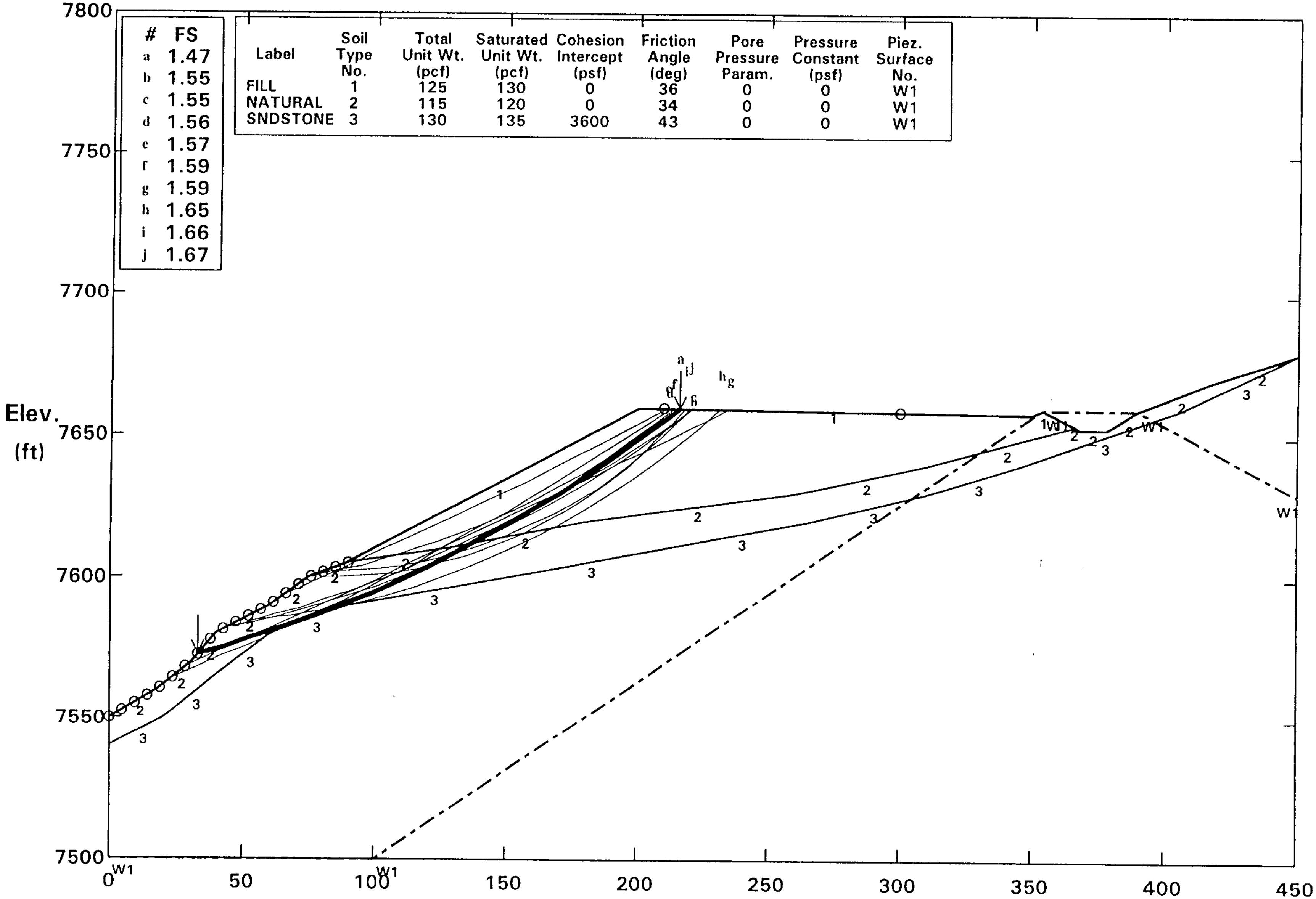
We appreciate the opportunity to provide this service for you. Please call if you have any questions or comments regarding the analytical results presented with this letter, please call.

Respectfully Submitted,
DAMES & MOORE

G. Alexander Rush, P.E.
Senior Geotechnical Engineer
Professional Engineer No. 372768
State of Utah

PORTAL STAGING AREA, 2H:1V SLOPES Section A-A', July 1999 Study

Ten Most Critical. P:AA99.PLT By: Doug Giffin 07-14-99 2:08pm

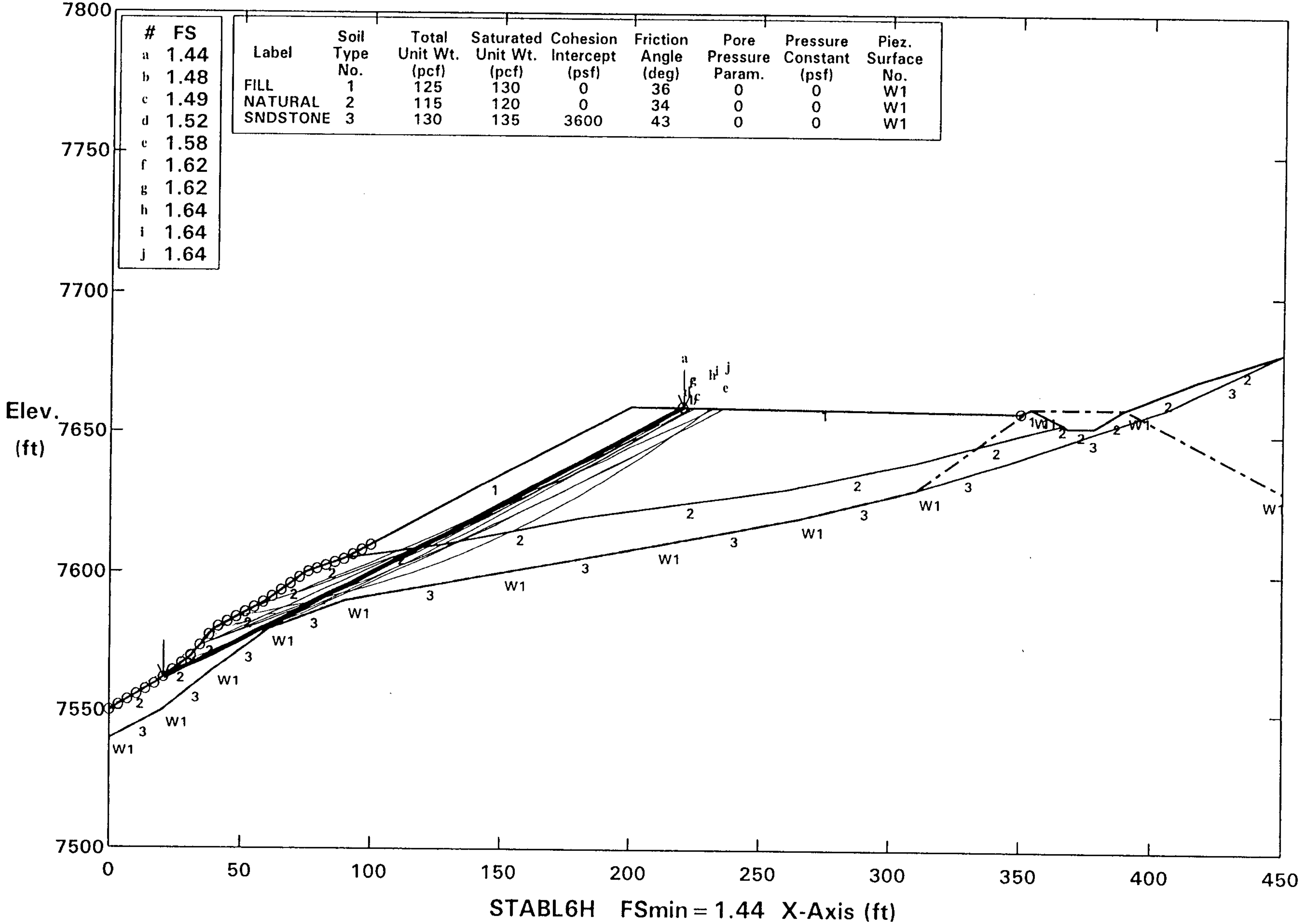



STABL6H FSmin = 1.47 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A', July 1999 Study

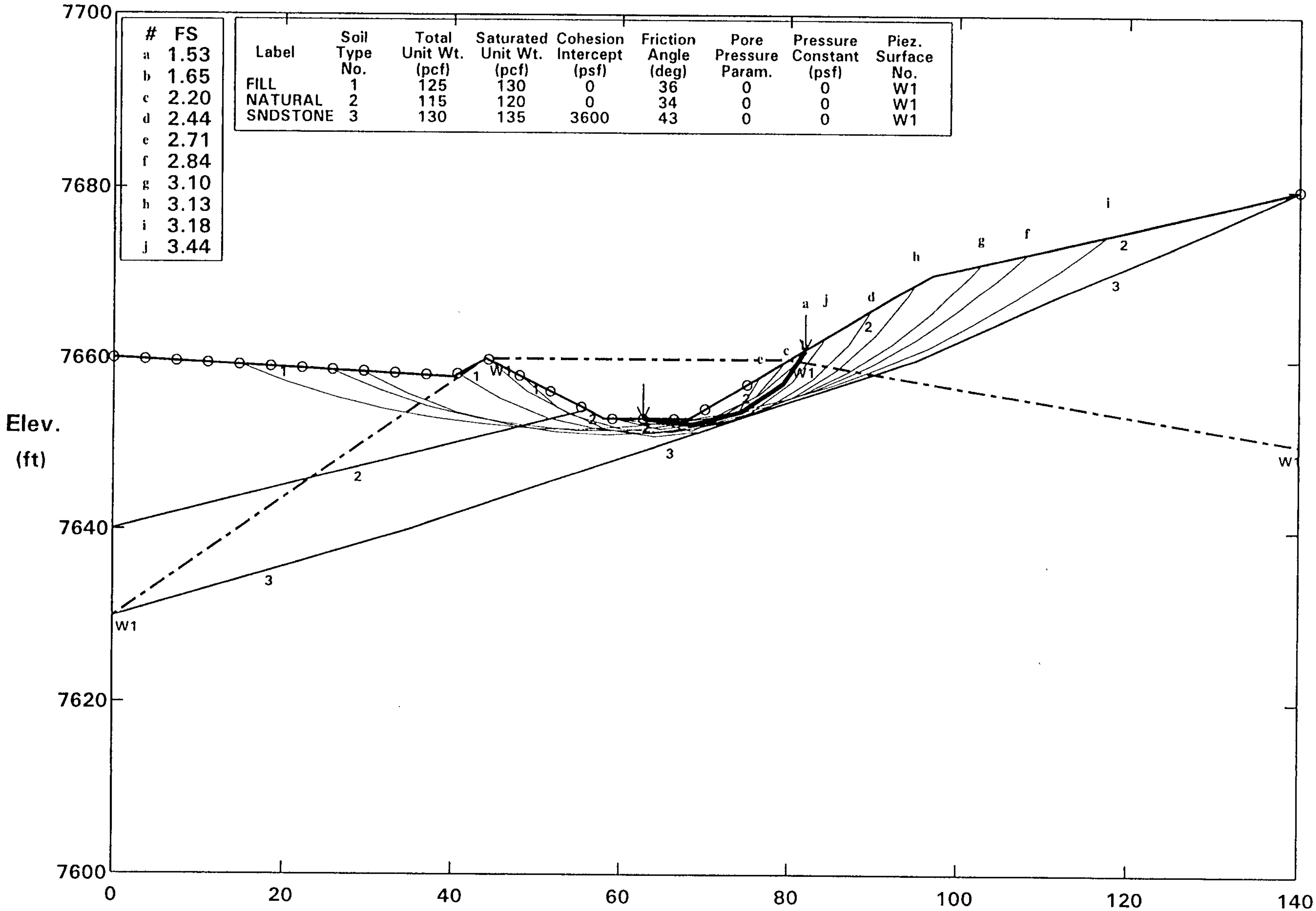
Ten Most Critical. P:AA99W.PLT By: Doug Giffin 07-16-99 1:14pm




Factors Of Safety Calculated By The Modified Bishop Method

# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A', July 1999 Study

Ten Most Critical. P:AA99PS.PLT By: Doug Giffin 07-14-99 2:22pm

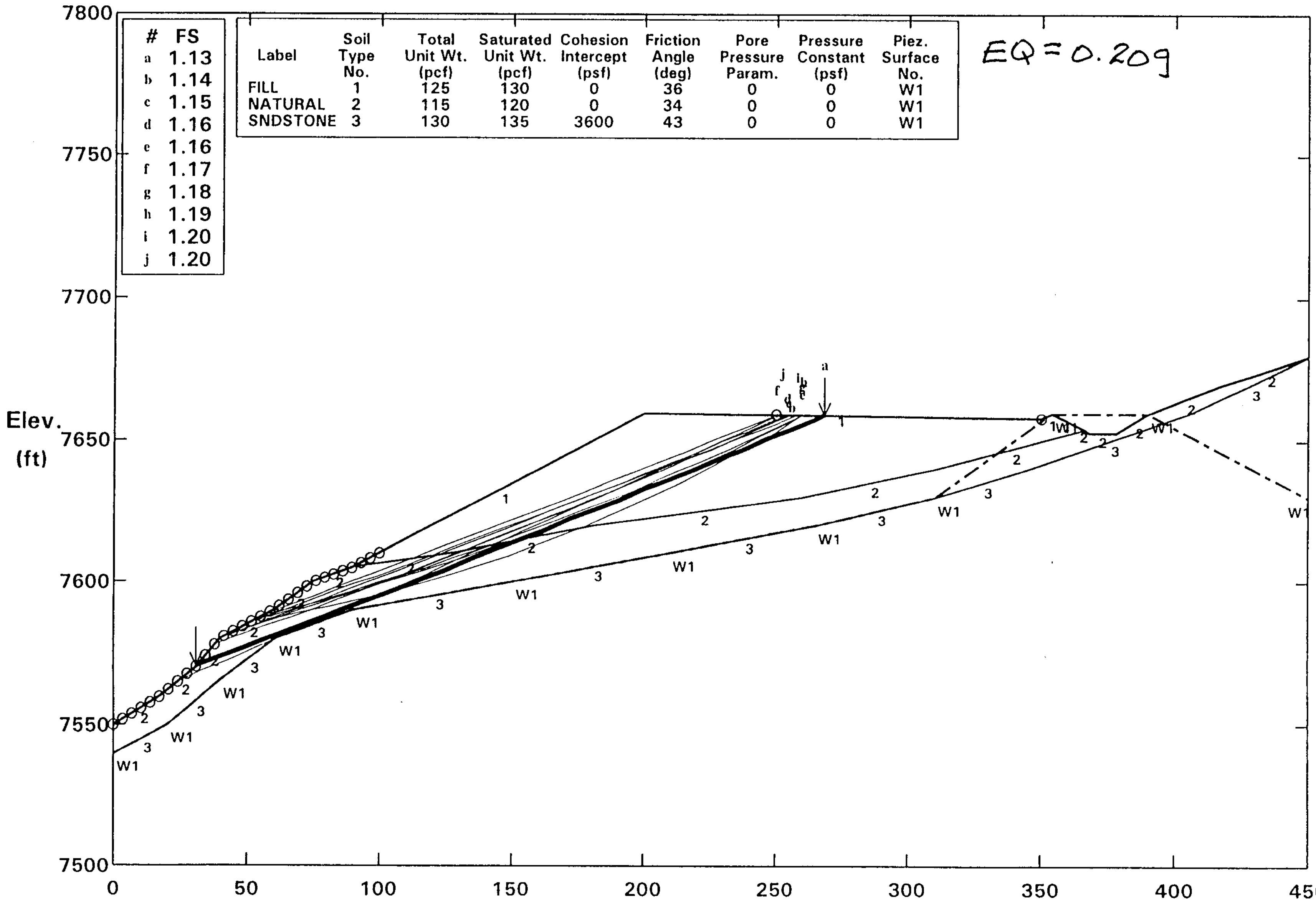



STABL6H FSmin = 1.53 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A', July 1999 Study

Ten Most Critical. P:AA99WEQ.PLT By: Doug Giffin 07-16-99 1:10pm



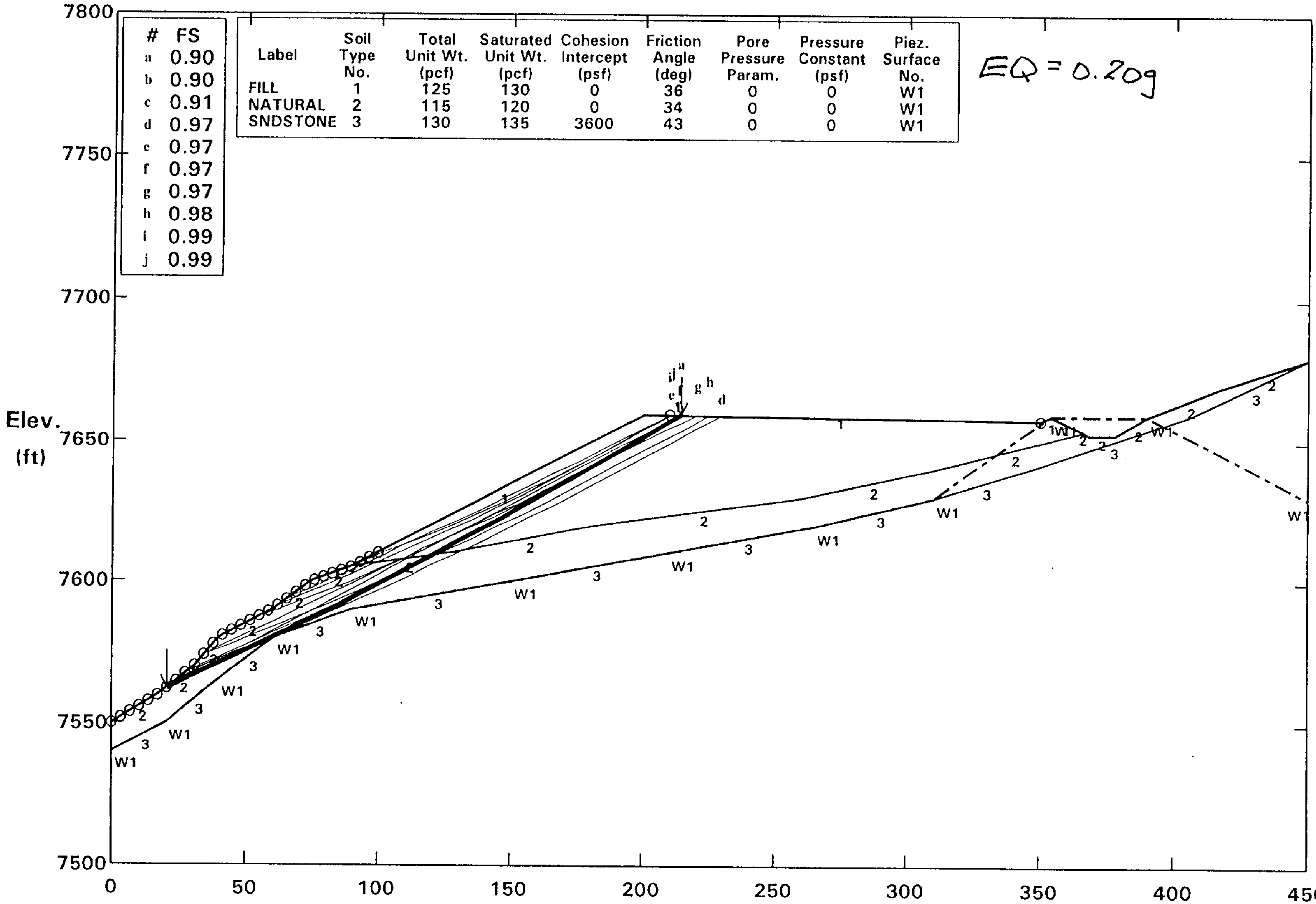

| Label | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No. |
|---|---|---|---|---|---|---|---|---|
| FILL | 1 | 125 | 130 | 0 | 36 | 0 | 0 | W1 |
| NATURAL | 2 | 115 | 120 | 0 | 34 | 0 | 0 | W1 |
| SNDSTONE | 3 | 130 | 135 | 3600 | 43 | 0 | 0 | W1 |

STABL6H FSmin = 1.13 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

# PORTAL STAGING AREA, 2H:1V SLOPES Section A-A', July 1999 Study

Ten Most Critical. P:AA99WEQ.PLT By: Doug Giffin 07-16-99 1:13pm




| # | FS |
|---|---|
| a | 0.90 |
| b | 0.90 |
| c | 0.91 |
| d | 0.97 |
| e | 0.97 |
| f | 0.97 |
| g | 0.97 |
| h | 0.98 |
| i | 0.99 |
| j | 0.99 |

| Label | Soil Type No. | Total Unit Wt. (pcf) | Saturated Unit Wt. (pcf) | Cohesion Intercept (psf) | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant (psf) | Piez. Surface No. |
|---|---|---|---|---|---|---|---|---|
| FILL | 1 | 125 | 130 | 0 | 36 | 0 | 0 | W1 |
| NATURAL | 2 | 115 | 120 | 0 | 34 | 0 | 0 | W1 |
| SNDSTONE | 3 | 130 | 135 | 3600 | 43 | 0 | 0 | W1 |

STABL6H FSmin = 0.90 X-Axis (ft)

Factors Of Safety Calculated By The Modified Bishop Method

# Attachment B

# Slope Stability Analysis
# Post-Mining Slopes

**URS**

February 28, 2001

Mr. Charles Reynolds
C. W. Mining Company
P.O. Box 1245
Huntington, Utah 84528

**REPORT – Slope Stability Evaluation For Reclaimed Slopes along Upper and Lower Conveyor Access Roads and in Portal Area**
C. W. Mining Company
Wild Horse Ridge, Bear Canyon No. 3
Huntington, Utah
Job No. H5-00001696.00

## INTRODUCTION

This report presents the results of our slope stability evaluation for the proposed reclaimed slopes along the proposed upper and lower conveyor access roads and in the portal area at Wild Horse Ridge, Bear Canyon No. 3 near Huntington, Utah. URS (then Dames & Moore) has preformed previous work in this area for C. W. Mining (then CO-OP Mining Company). This previous work involved slope stability evaluations of cut and fill slopes for these features (see report number 27437-005-162, dated October 7, 1996, and letter report dated July 23, 1999).

## SCOPE OF WORK

The scope of work for this evaluation was outlined in our proposal, dated January 30, 2001. Written authorization to perform the work was provided by signature on January 31, 2001. The evaluation of the proposed reclaimed slopes was based on plans and cross sections at 100-foot stations provided by C. W. Mining. Per your request, a geotechnical investigation was not included as part of this scope of work. Subsurface conditions and strength parameters used in our evaluation are based on the results of the previously performed work identified above.

## PROPOSED CONSTRUCTION

C. W. Mining is anticipating mining new coal seams in the Wild Horse Ridge area. The portal location can generally be accessed by an existing route; however, the canyon below the portal area will be filled to allow for portal access and construction staging. Coal from the mine will be transported to the current processing facility via a new conveyor system.

An access road will be constructed in order to build, and later maintain, the conveyor system. The road will basically consist of two segments: upper and lower. It is our understanding that material excavated during construction of the access road will be used as fill and/or stockpiled until the mining operation is complete, at which time the material will be used to reclaim the cut slopes.

## SITE CONDITIONS

The majority of the proposed road cuts are in bedrock or in bedrock overlain by shallow colluvial soils. The bedrock consists principally of sandstone and siltstone. The colluvial soils consist of primarily silty gravel and silty sand. Cobbles and boulders make up an estimated 20 to 40 percent of the colluvium. A more detailed description of site conditions is contained in previously prepared reports.

Based on previous field observations and laboratory testing of two bulk samples, the colluvium was assigned a friction angle of 34 degrees with no cohesion. Excavated bedrock materials are expected to possess at least similar strength properties.

## RESULTS OF SLOPE STABILITY EVALUATION

We understand from C. W. Mining that a factor of safety of 1.3 is required for the reclaimed slopes. For the strength properties stated above, the maximum slope that can be used while maintaining the required factor of safety is basically 2(H):1(V), or 27 degrees from horizontal. Since some of the proposed cuts are in areas where, due to bedrock, the natural slope is significantly steeper than 2:1, some of the cuts would remain partially exposed. Table 1 presents, by station, the areas in which the proposed reclamation grading satisfies the factor of safety criterion. For those areas not satisfying the factor of safety criterion, Table 1 also presents how much estimated cut would remain exposed if the proposed grading is reduced to a maximum slope of 2:1. Figure 1 illustrates this relationship between grading and the vertical height of the exposed cut.

An asterisk has be used in Table 1 to indicate locations where grading could likely be adjusted without great difficulty from that shown on the cross sections, thus reducing the vertical height of the exposed cut. Such an adjustment in proposed grading is illustrated in Figure 2. The cross sections used in our evaluation are contained in Appendix A.

## DISCUSSION AND RECOMMENDATIONS

Some of the 2:1 reclamation grading, especially along the Upper Conveyor Access Road, is not quite steep enough to completely cover the face of the proposed cut slope. One possible method of mitigation would be to locate the road further out away from the slope, lessening the height of the required cut. Another consideration might be to accept a small amount of exposed cut, but dressing the face so that it blends better into the natural environment. In some areas with a significant amount of exposed cut (such as Station 2+00 along the Upper Conveyor Access Road), the visual impact of the cut will be lessened by naturally occurring steep ledges immediately above the cut.

With respect to reclamation earthwork, a suitable degree of compaction should be obtained by achieving either 95% maximum density with respect to the standard Proctor test (ASTM D-698) or 70% relative density (ASTM D-4254). The later standard is preferable because of the nature of the materials being used. The maximum soil particle size should be limited to 1/2 the lift thickness, and materials should be placed and worked as to minimize void spaces between soil particles. Lift thickness is a function of the compaction method and equipment, but it generally should be no greater than 24 inches unless testing shows adequate compaction of the entire lift can be obtained using thicker lifts.

To help control erosion and improve stability, reclaimed slopes can be revegetated. Vegetation should be preferably native and not require irrigation. Oversized materials can also be used at the fill's surface to provide additional erosion protection. Drainage should be established such that it is directed away from reclaimed slopes.

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# TABLE 1

**No. 3 Mine Portal Area**

| Section Station | Approximate Height of Cut Slope (ft) | C-W Proposed Reclamation Avg. Slope (deg) | Satisfies F.S =1.3 Criteria (y/n)? | Estimated Height of Exposed Cut with F.S =1.3 (ft) |
|---|---|---|---|---|
| 0+00 | 11 | 6 to 31 | yes * | none * |
| 1+00 | 14 | 13 to 33 | yes * | none * |
| 2+00 | 36 | 27 | yes | none |
| 3+00 | 38 | 27 | yes | none |
| 4+00 | 48 | 22 to 39 | no | 20 |
| 5+00 | 30 | 42 | no | 16 |

* Possible if grading is adjusted from that shown on the cross section with slopes no steeper than 2H:1V (27 deg) from toe of cut

**Lower Conveyor Access Road**

| Section Station | Approximate Height of Cut Slope (ft) | C-W Proposed Reclamation Avg. Slope (deg) | Satisfies F.S =1.3 Criteria (y/n)? | Estimated Height of Exposed Cut with F.S =1.3 (ft) |
|---|---|---|---|---|
| 0+00 | none (remove fill) | 0 to 7 | yes | none |
| 1+00 | none (remove fill) | 11 | yes | none |
| 2+00 | none (remove fill) | 19 | yes | none |
| 3+00 | none (remove fill) | 10 to 17 | yes | none |
| 4+00 | 29 | 29 | no | 2 |
| 5+00 | 30 | 33 | no | 9 |
| 6+00 | 11 | 22 to 0 | yes | none |

**Upper Conveyor Access Road**

| Section Station | Approximate Height of Cut Slope (ft) | C-W Proposed Reclamation Avg. Slope (deg) | Satisfies F.S =1.3 Criteria (y/n)? | Estimated Height of Exposed Cut with F.S =1.3 (ft) |
|---|---|---|---|---|
| 0+00 | none (remove fill) | 0 to 12 | yes | none |
| 1+00 | 8 | 36 | no | 3 |
| 2+00 | 38 | 42 | no | 21 |
| 3+00 | 8 | 33 | no | 3 |
| 4+00 | 17 | 35 | no | 6 |
| 5+00 | 29 | 39 to 29 | no | 2 * |
| 6+00 | 15 | 38 to 51 | no | 5 ** |

* Possible if grading is adjusted from that shown on the cross section
** Smaller height possible (approx. 3 feet) if road is moved outward to opposing slope and cut slope height is reduced

# UPPER CONVEYOR ACCESS ROAD

## STATION 4+00

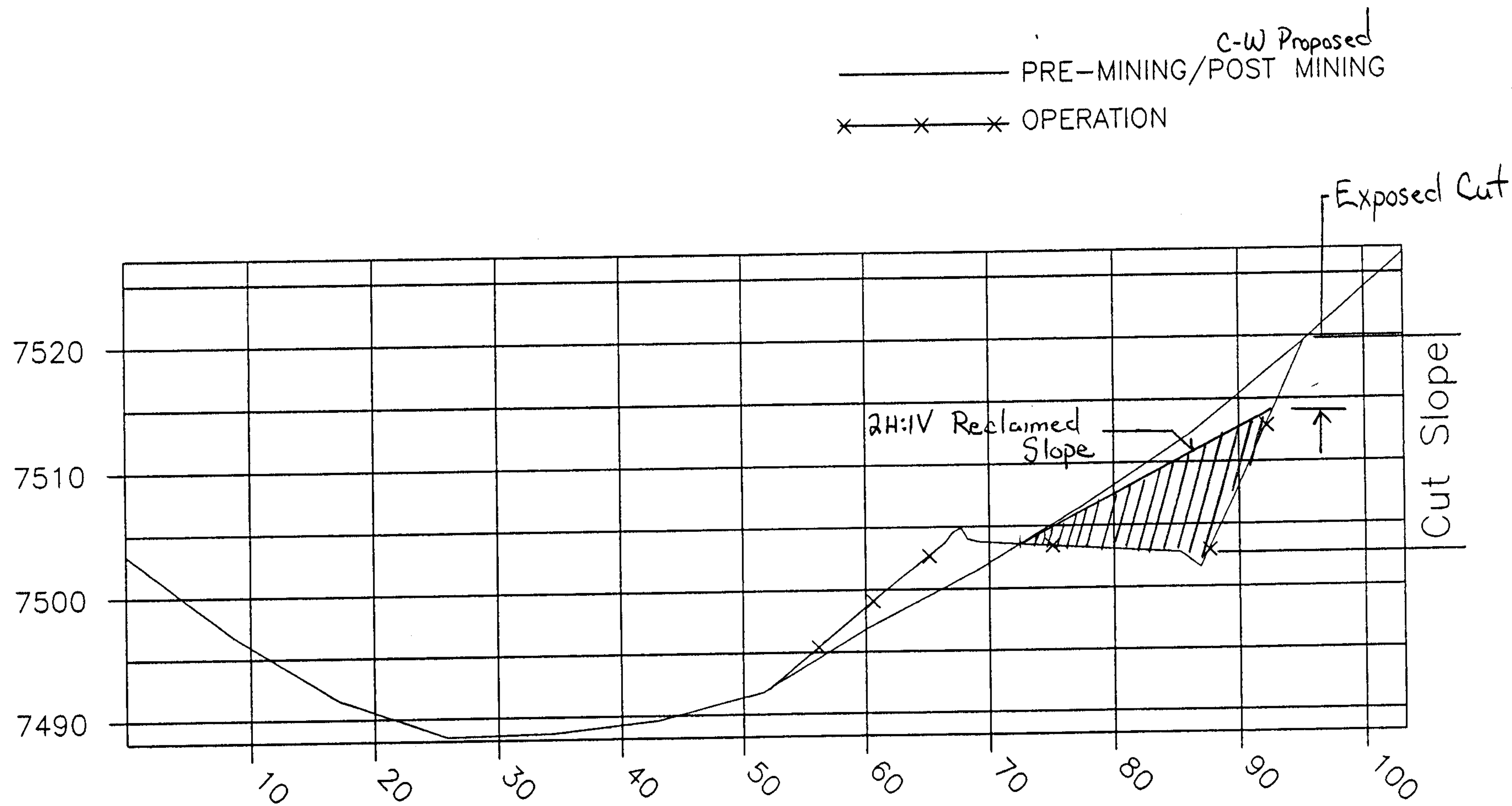



FIGURE 1

# UPPER CONVEYOR ACCESS ROAD

## STATION 5+00

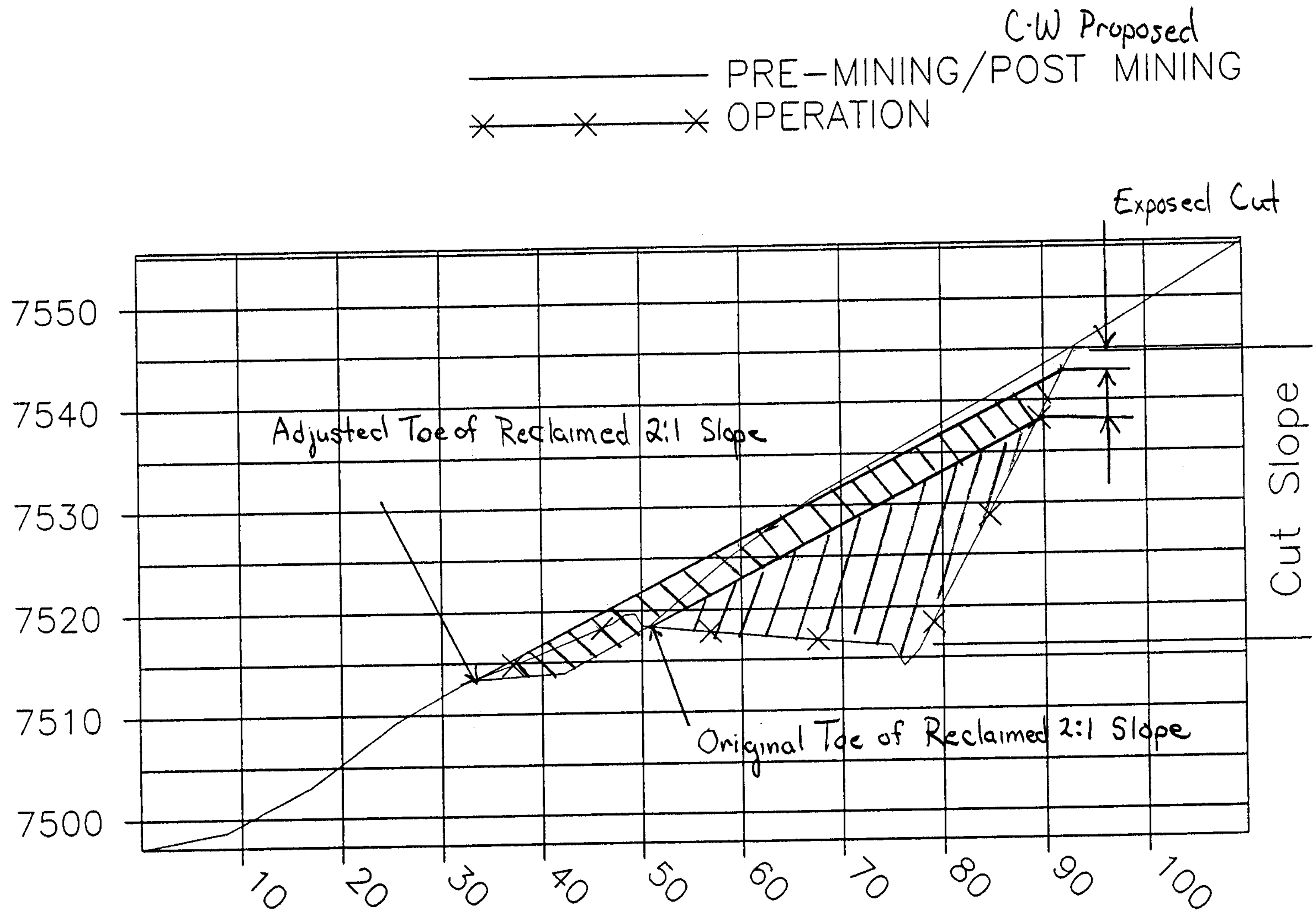


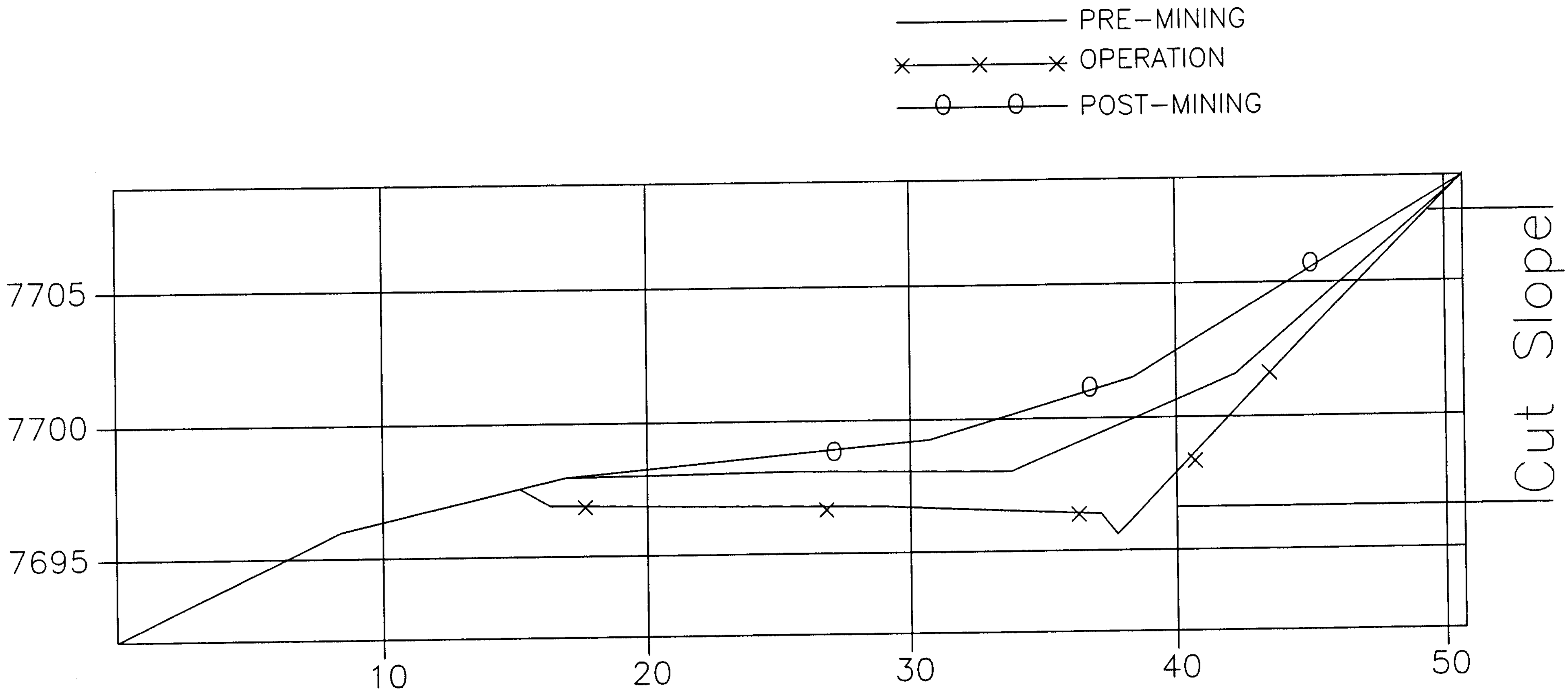

FIGURE 2

# APPENDIX A

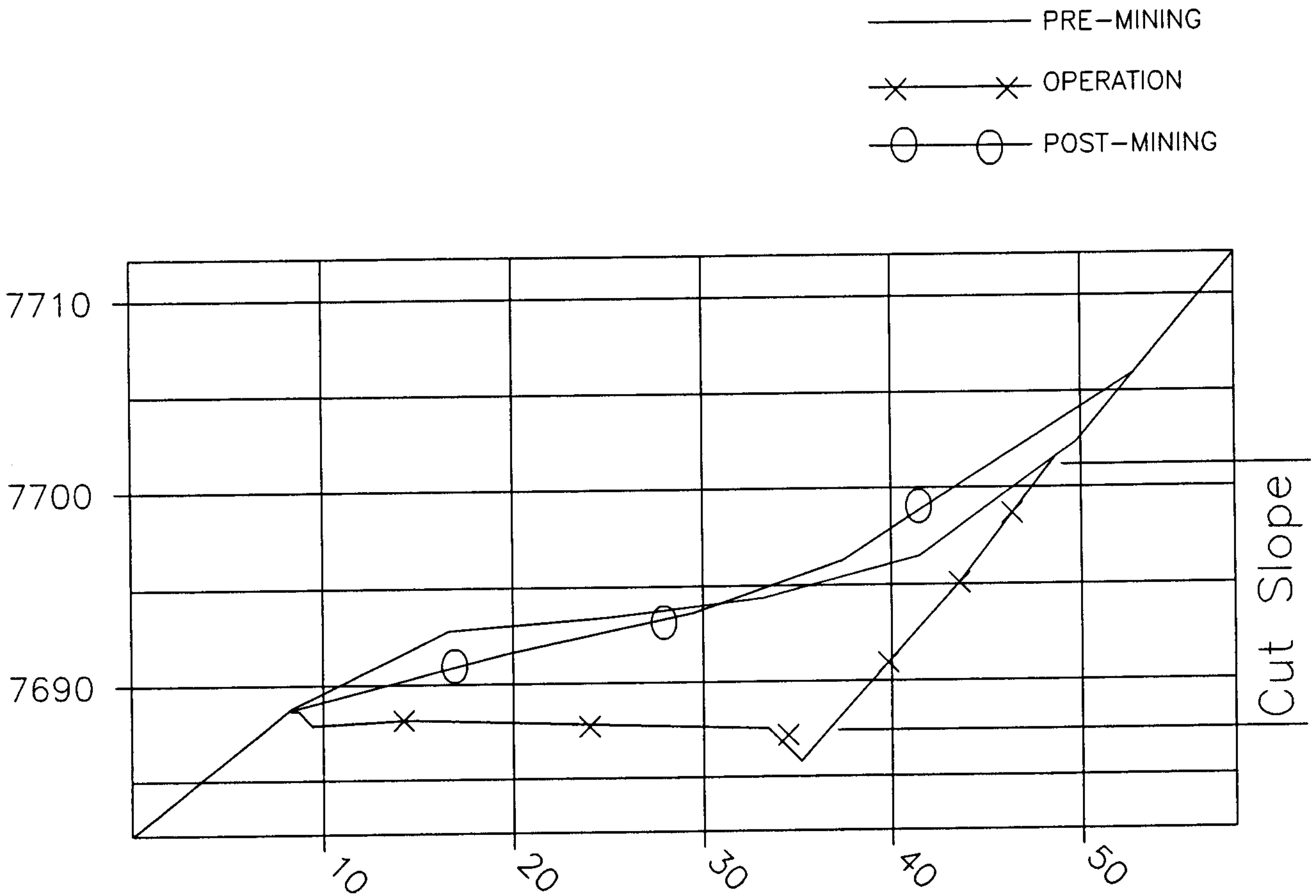
## CROSS SECTIONS
## USED IN SLOPE STABILITY EVALUATION

NO. 3 MINE PORTAL AREA

STATION 0+00

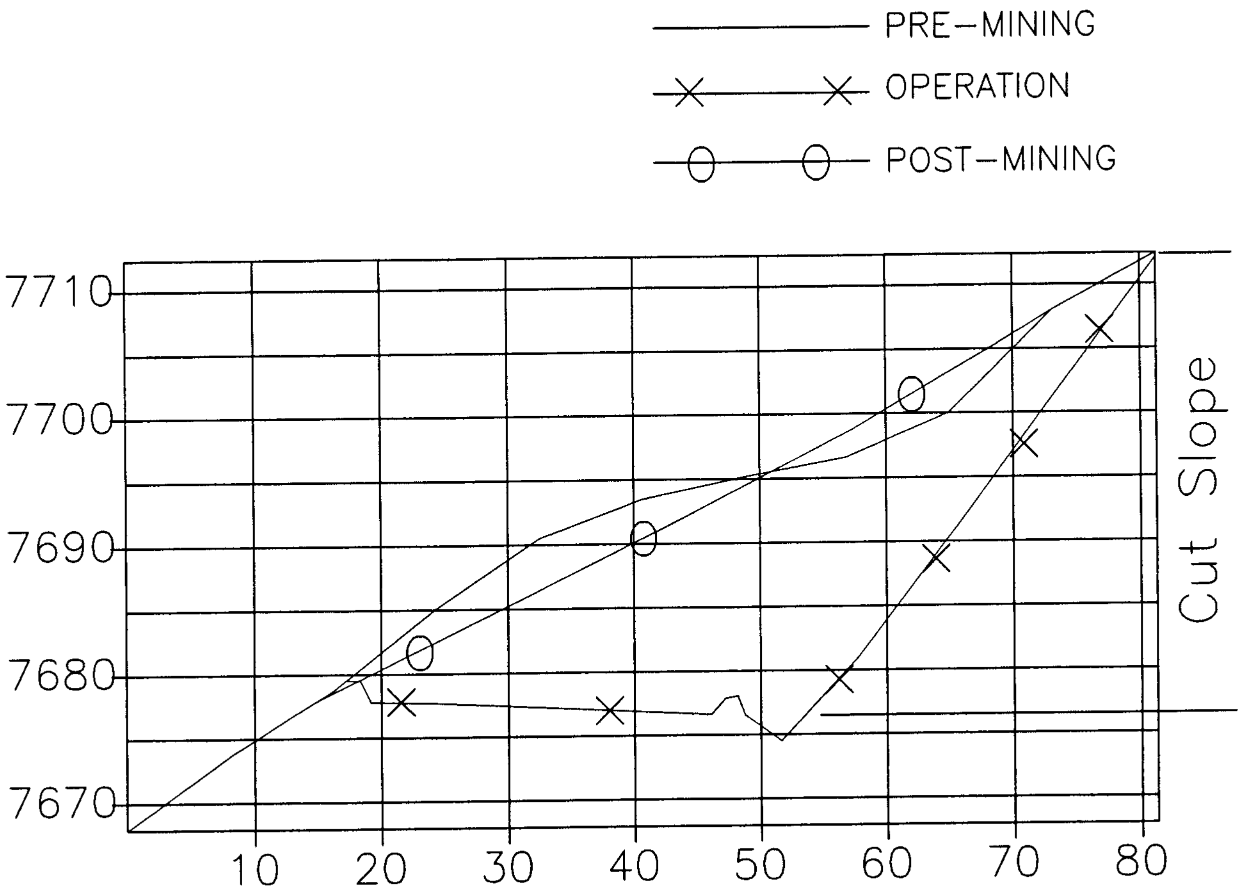


# NO. 3 MINE PORTAL AREA
## STATION 1+00



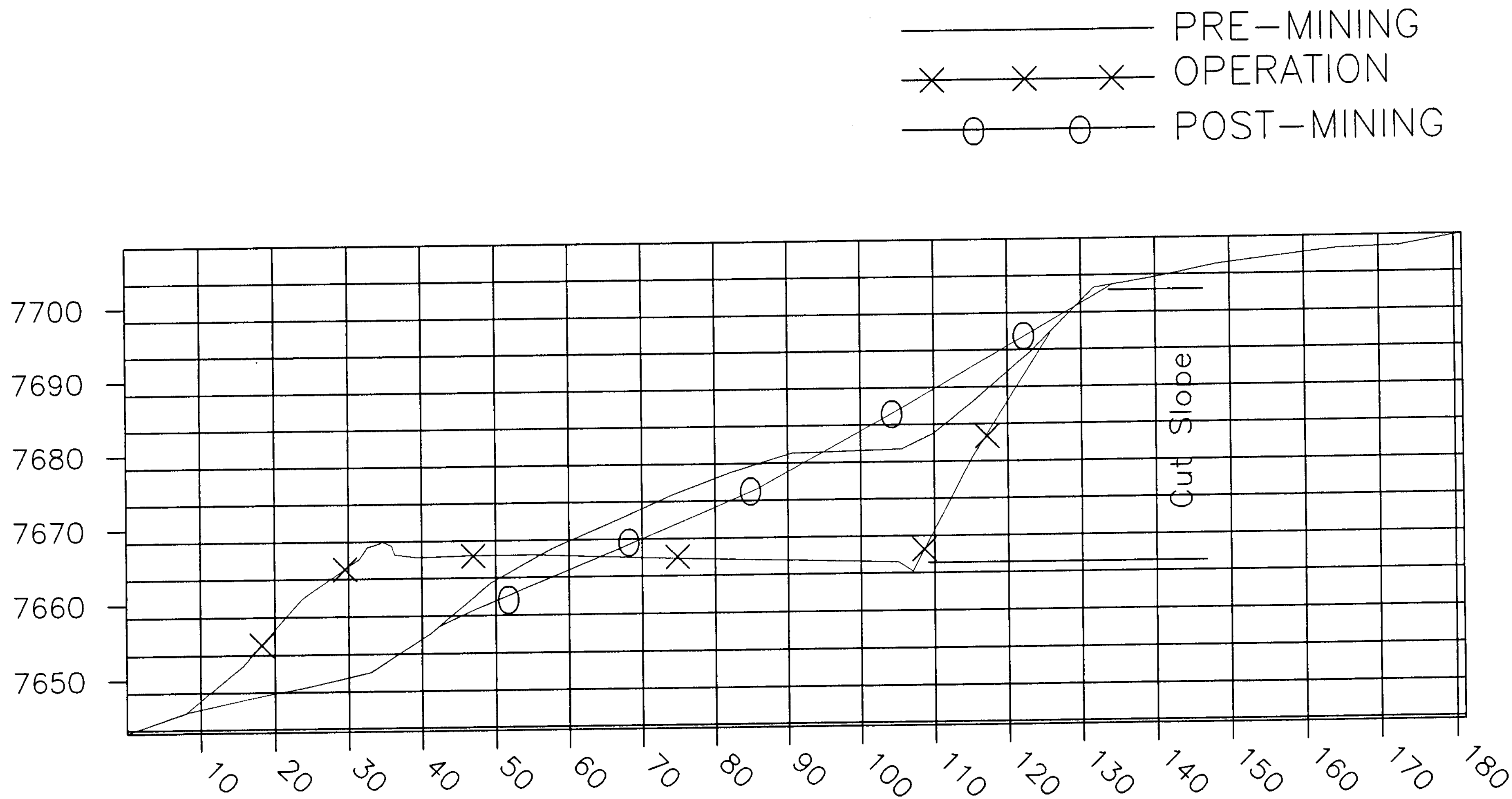
# NO. 3 MINE PORTAL AREA

## STATION 2+00



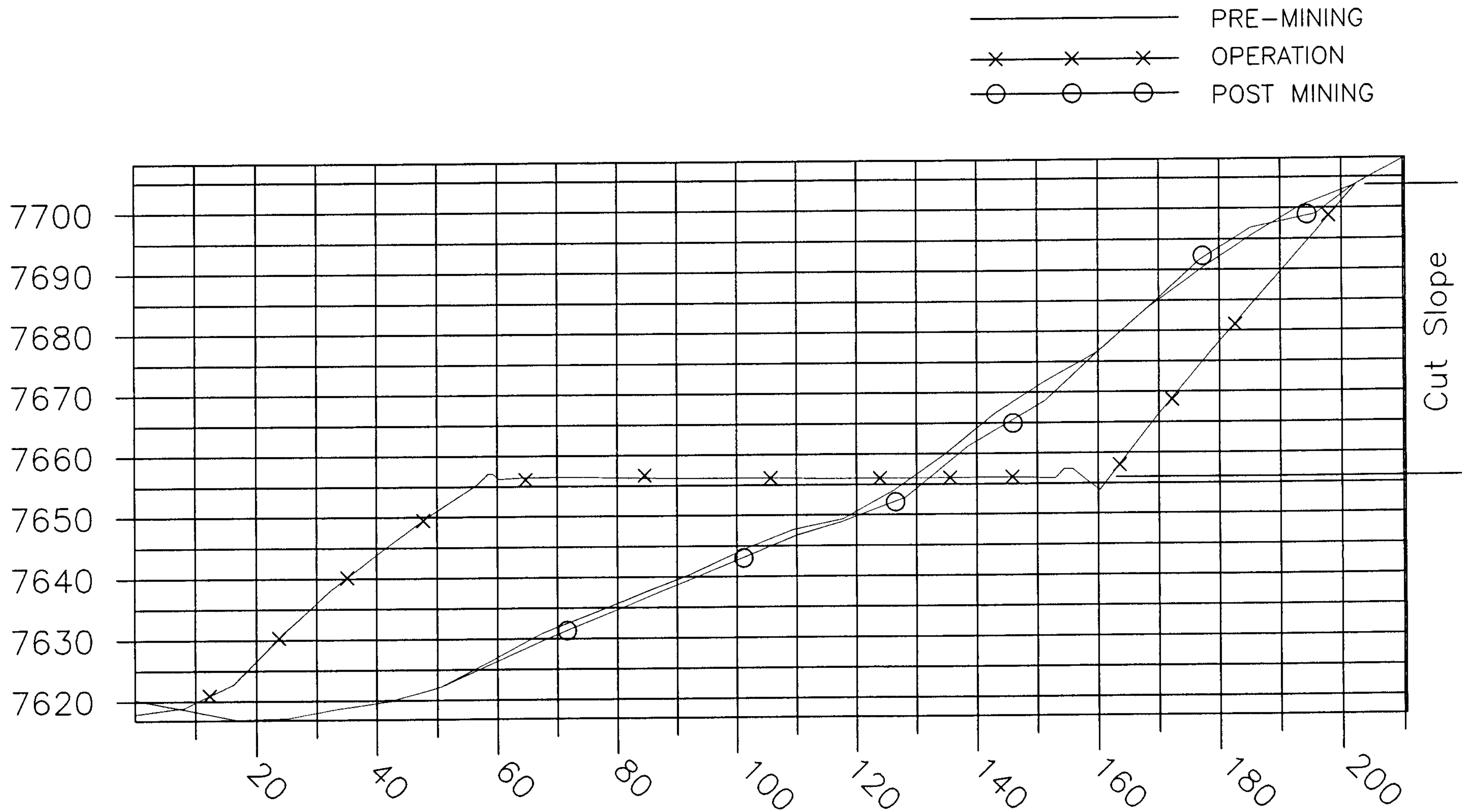
# NO. 3 MINE PORTAL AREA

## STATION 3+00



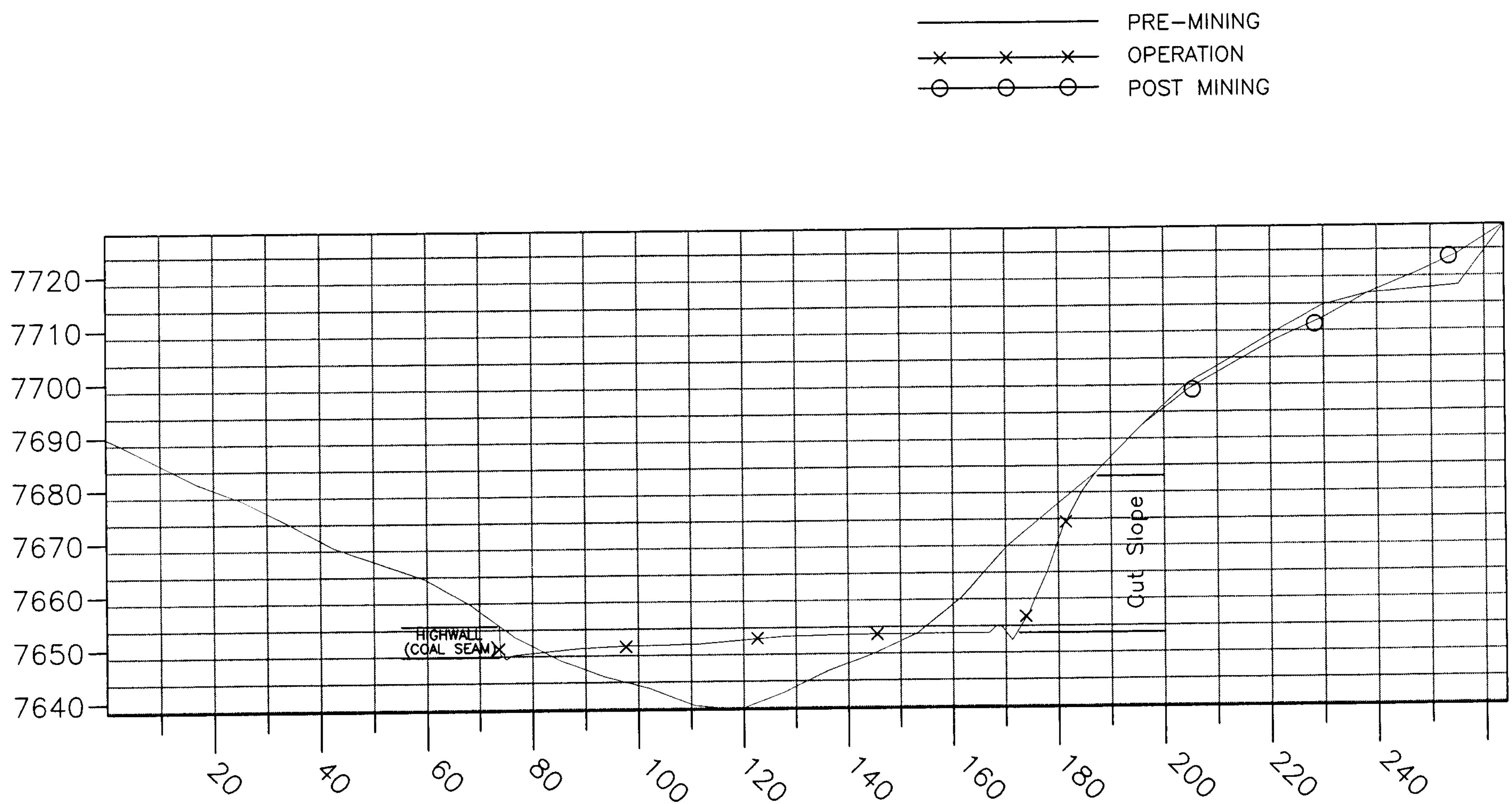
NO. 3 MINE PORTAL AREA

STATION 4+00



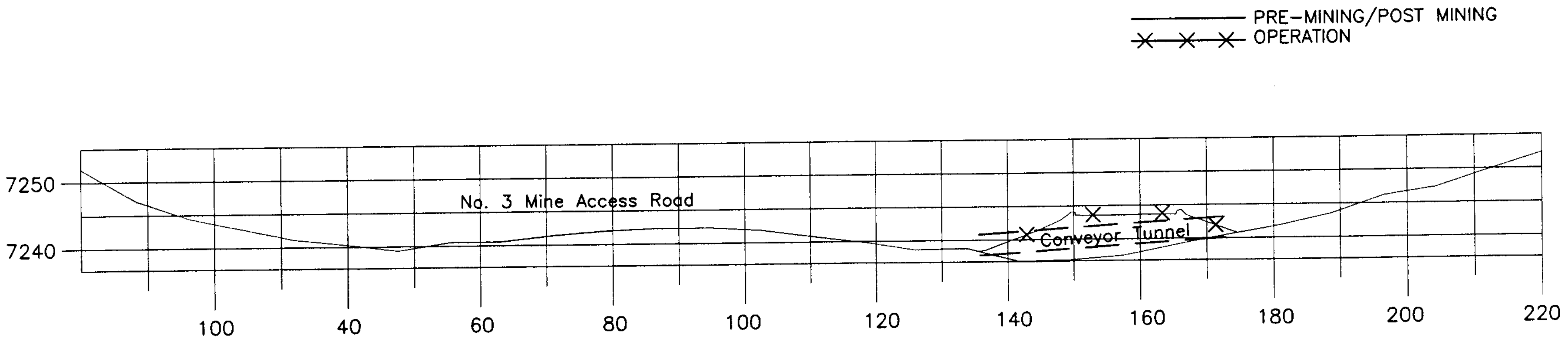
# NO. 3 MINE PORTAL AREA

## STATION 5+00



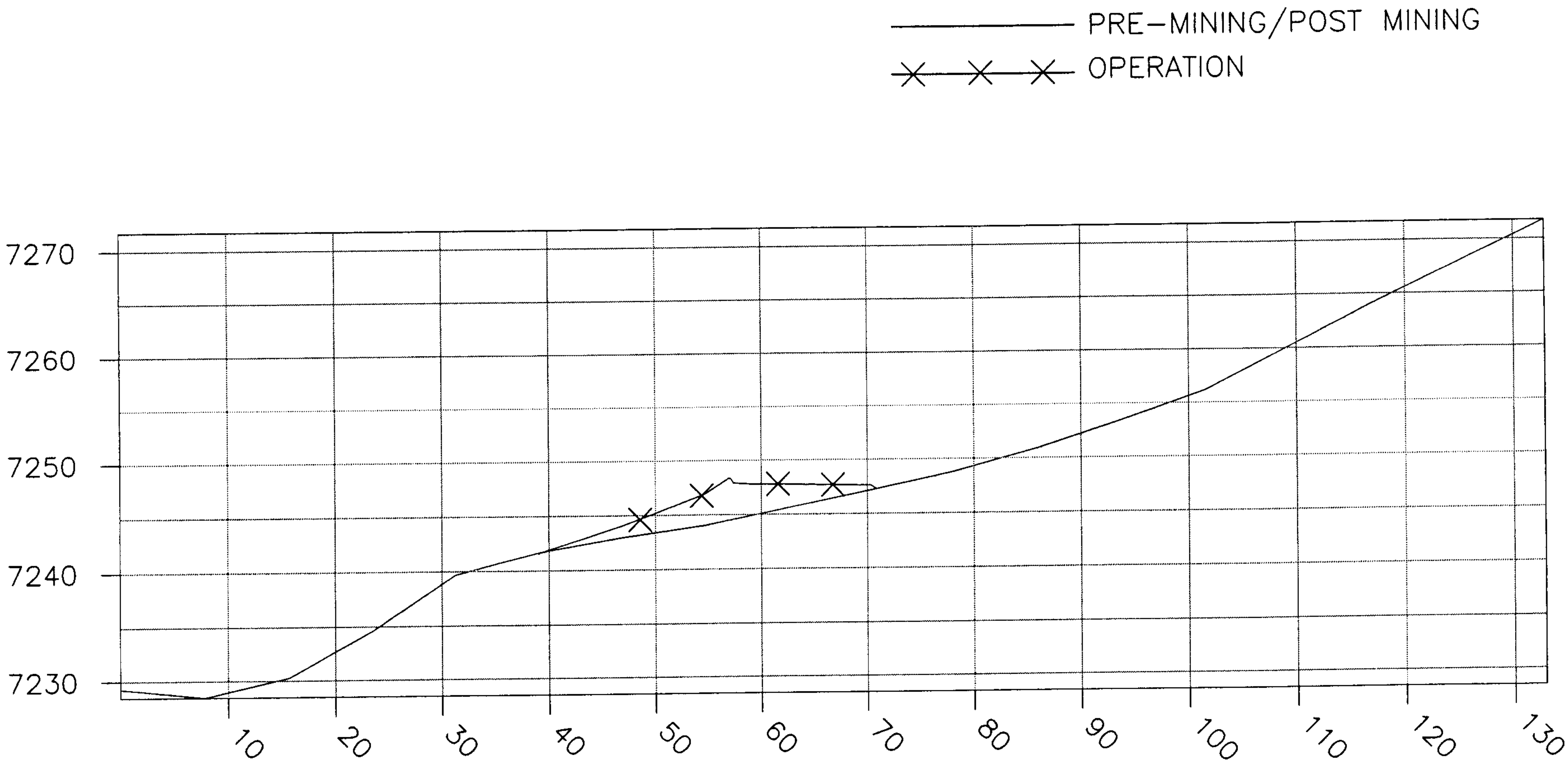
# LOWER CONVEYOR ACCESS ROAD

## STATION 0+00



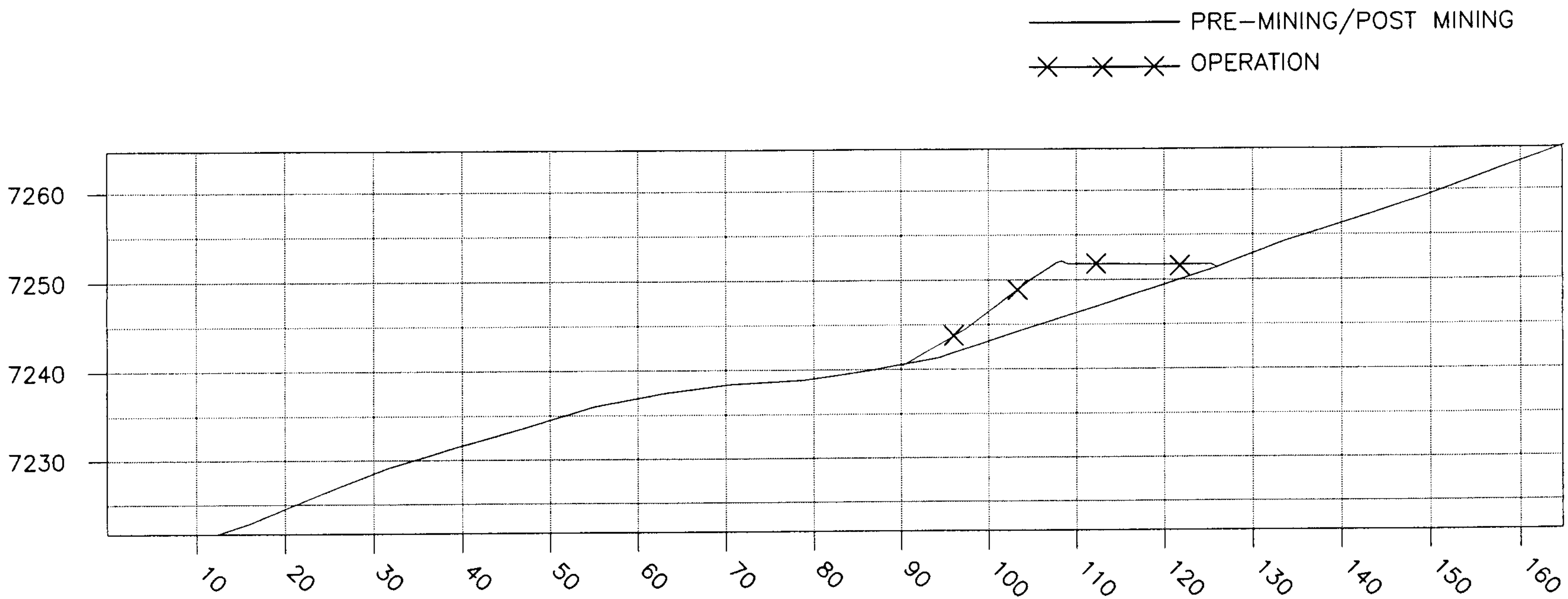
# LOWER CONVEYOR ACCESS ROAD

## STATION 1+00



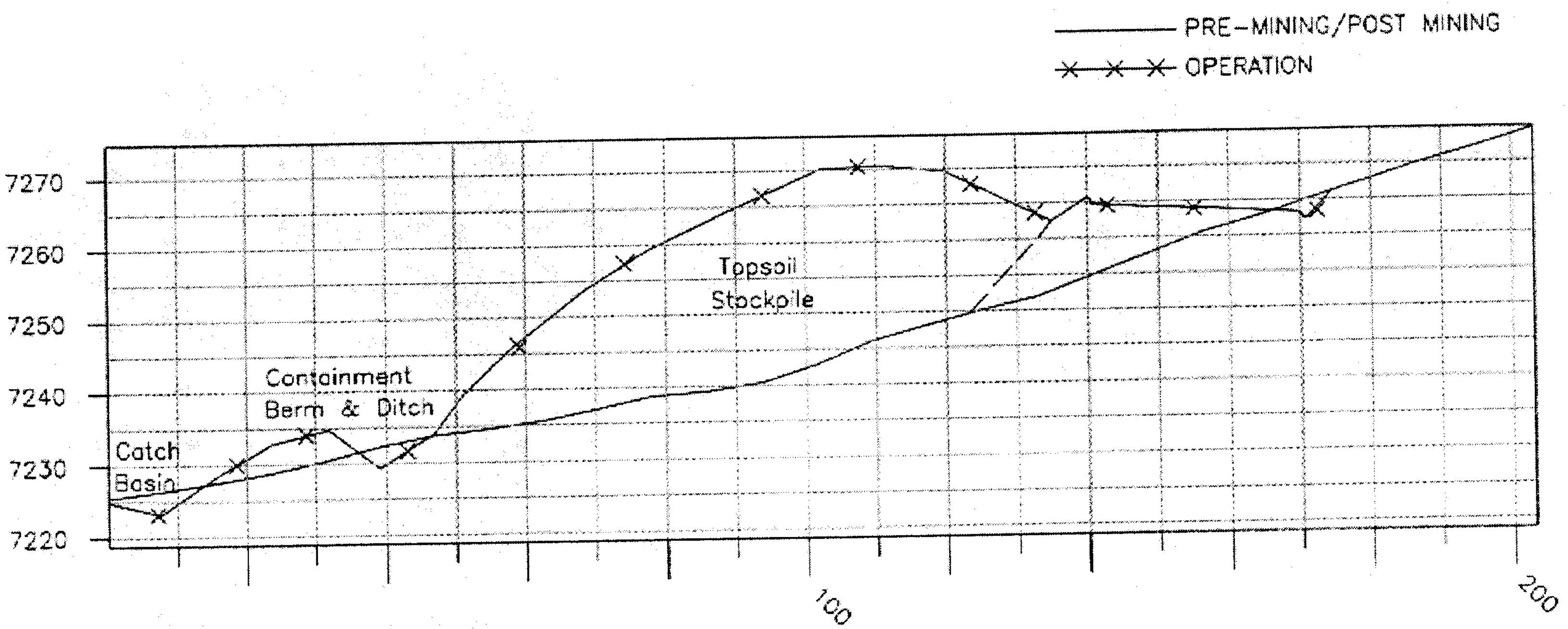
# LOWER CONVEYOR ACCESS ROAD

## STATION 2+00



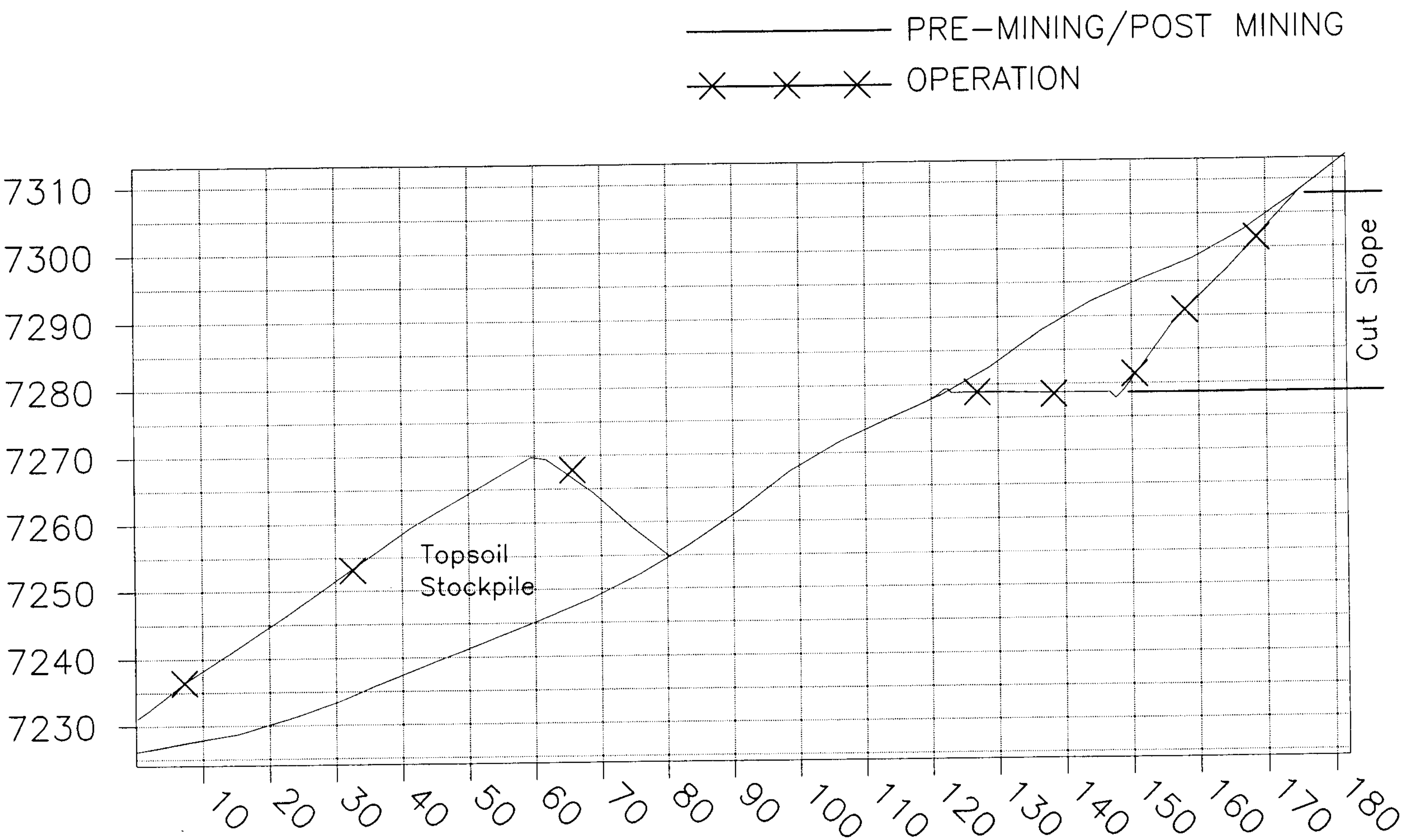
# LOWER CONVEYOR ACCESS ROAD

## STATION 03+00



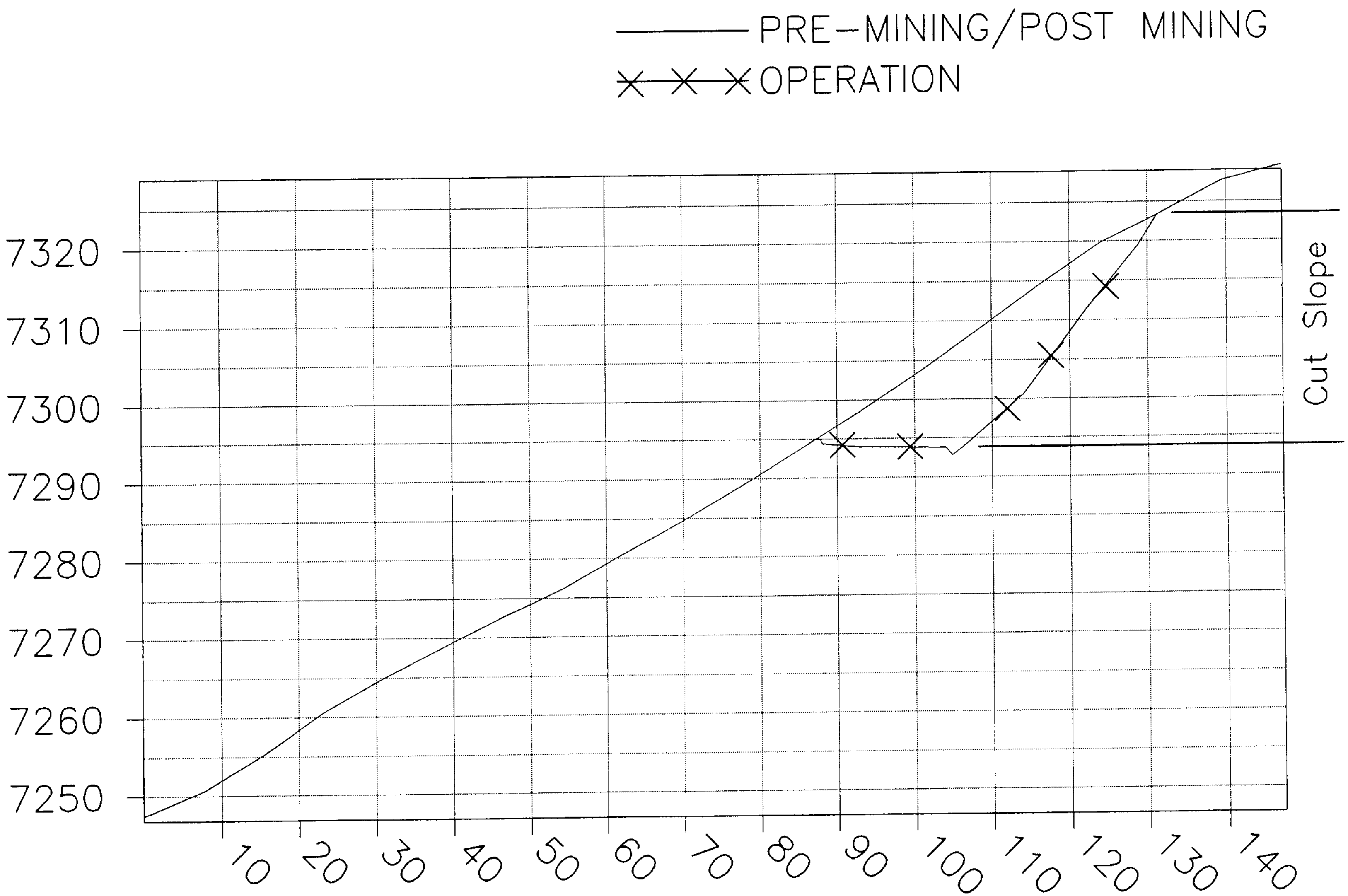
# LOWER CONVEYOR ACCESS ROAD

## STATION 4+00



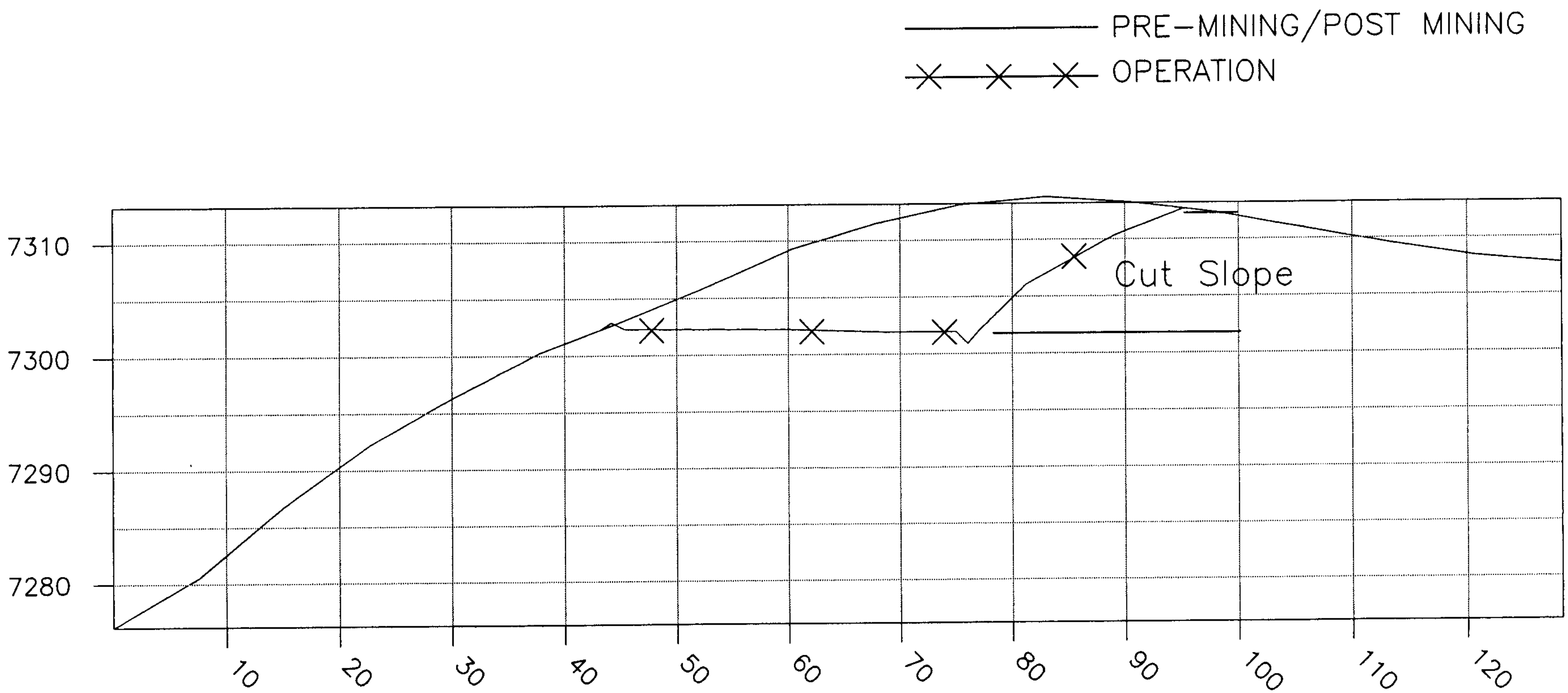
# LOWER CONVEYOR ACCESS ROAD

## STATION 5+00



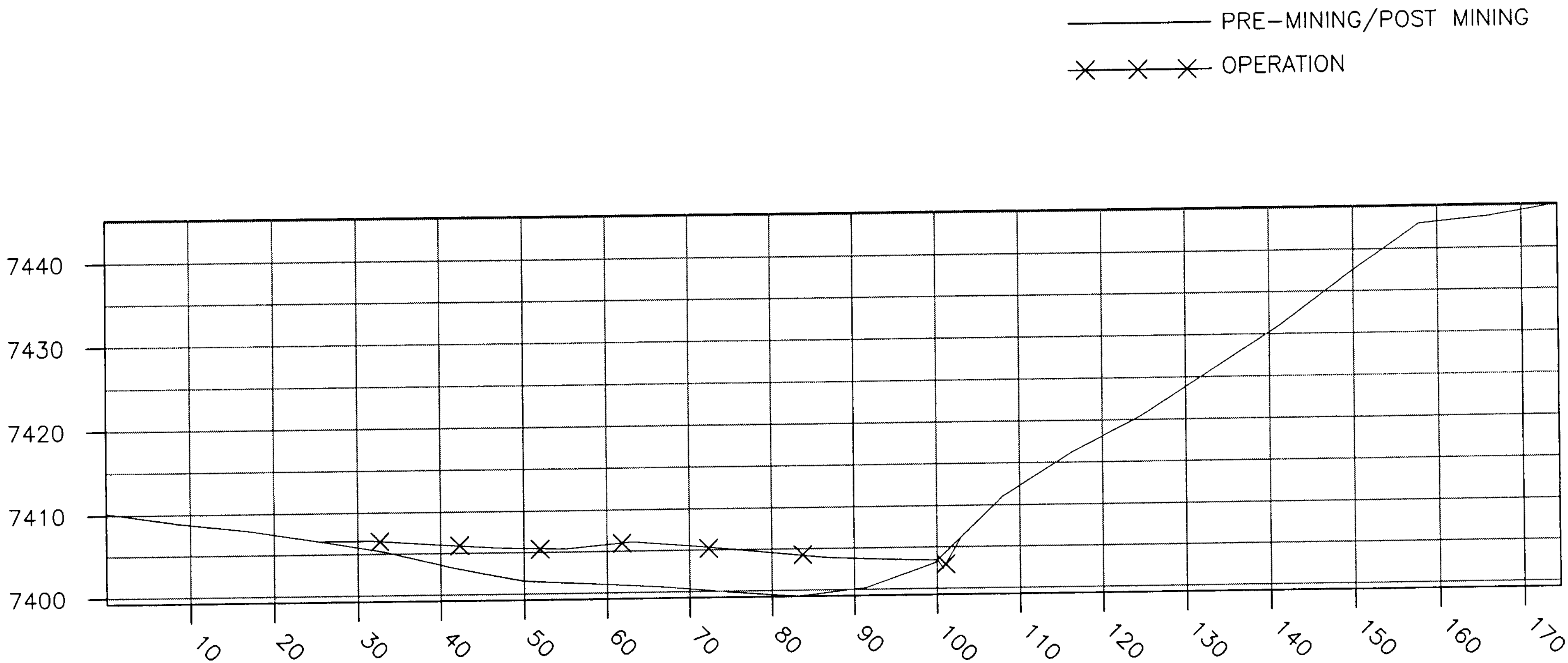
# LOWER CONVEYOR ACCESS ROAD

## STATION 6+00



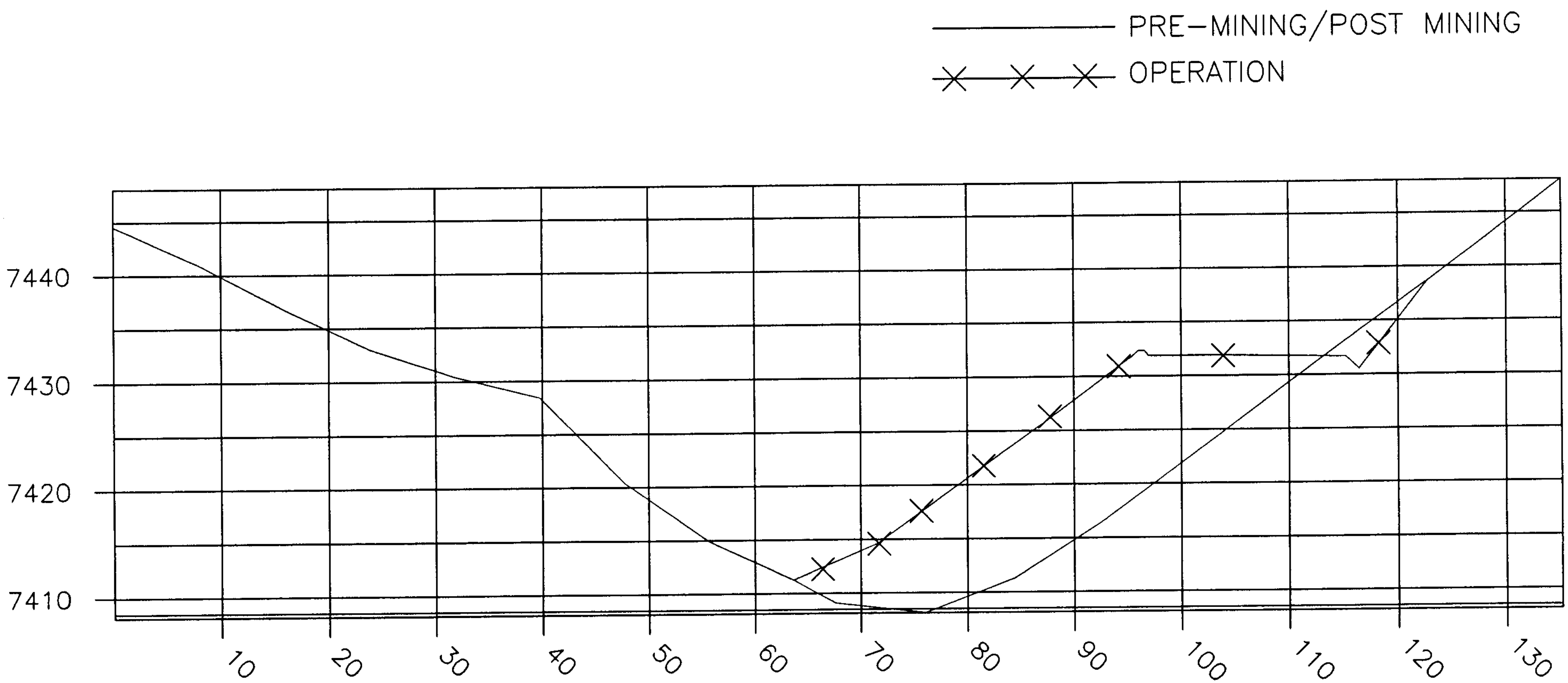
# UPPER CONVEYOR ACCESS ROAD

## STATION 0+00



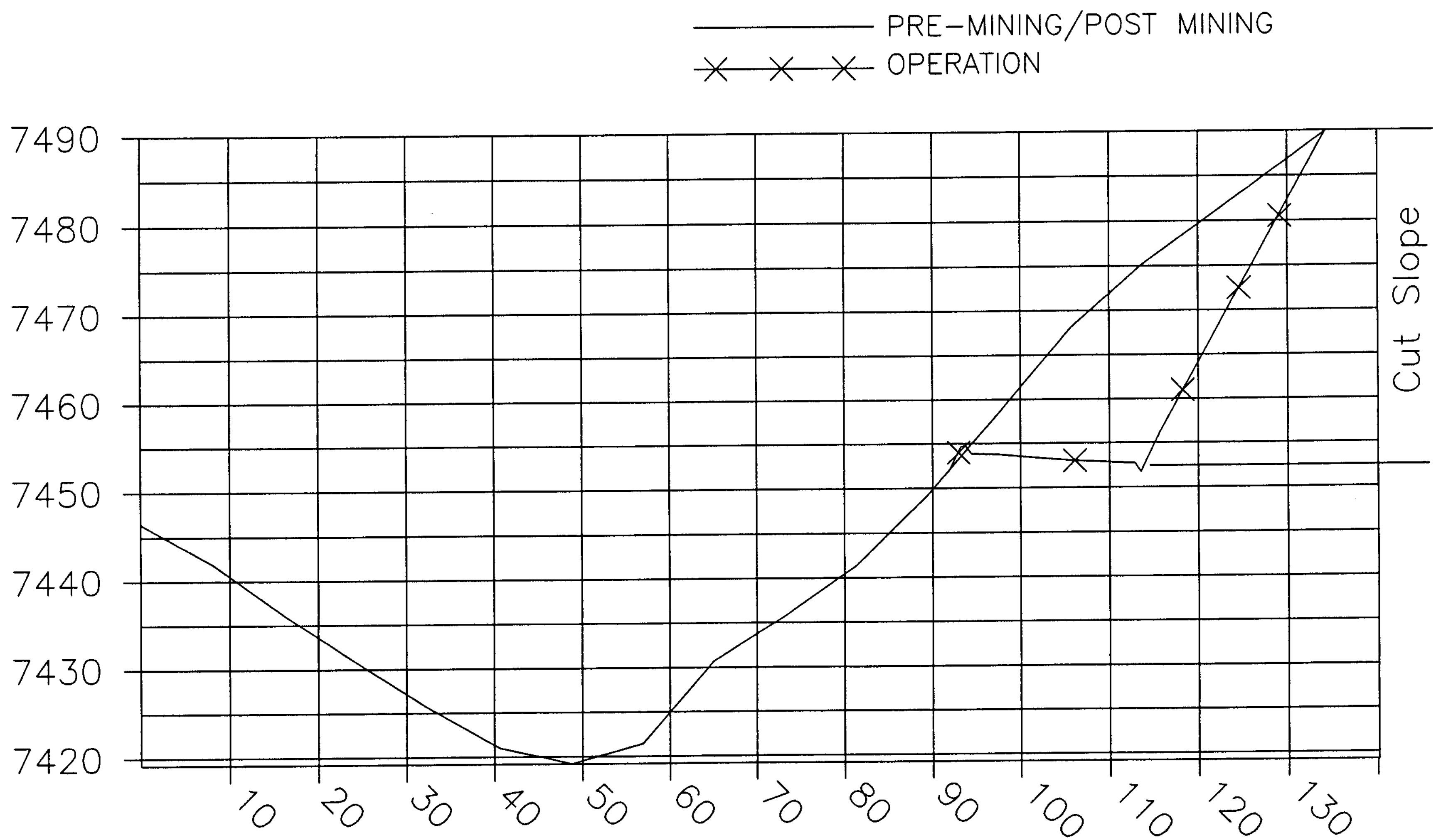
# UPPER CONVEYOR ACCESS ROAD

## STATION 1+00



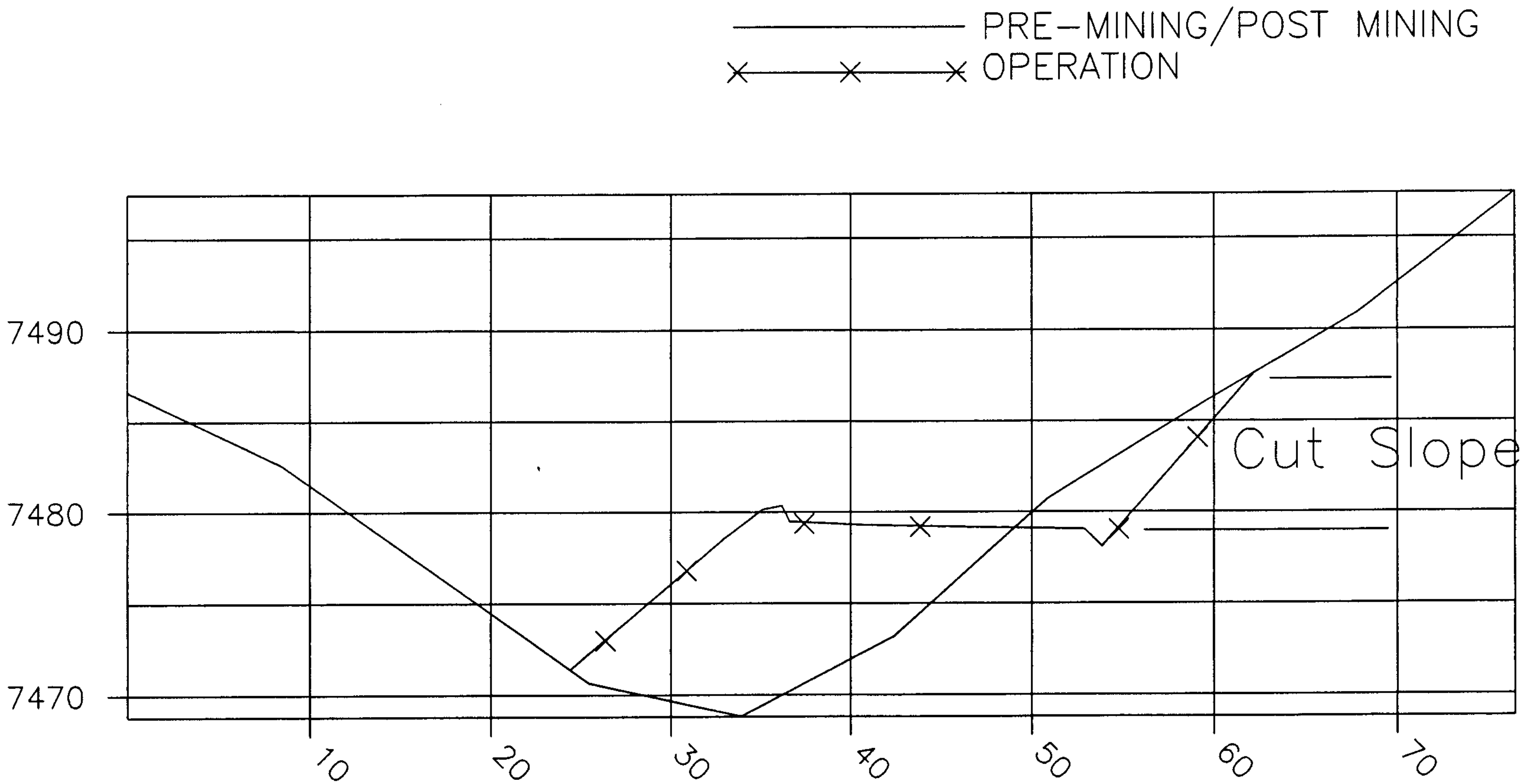
# UPPER CONVEYOR ACCESS ROAD

## STATION 2+00



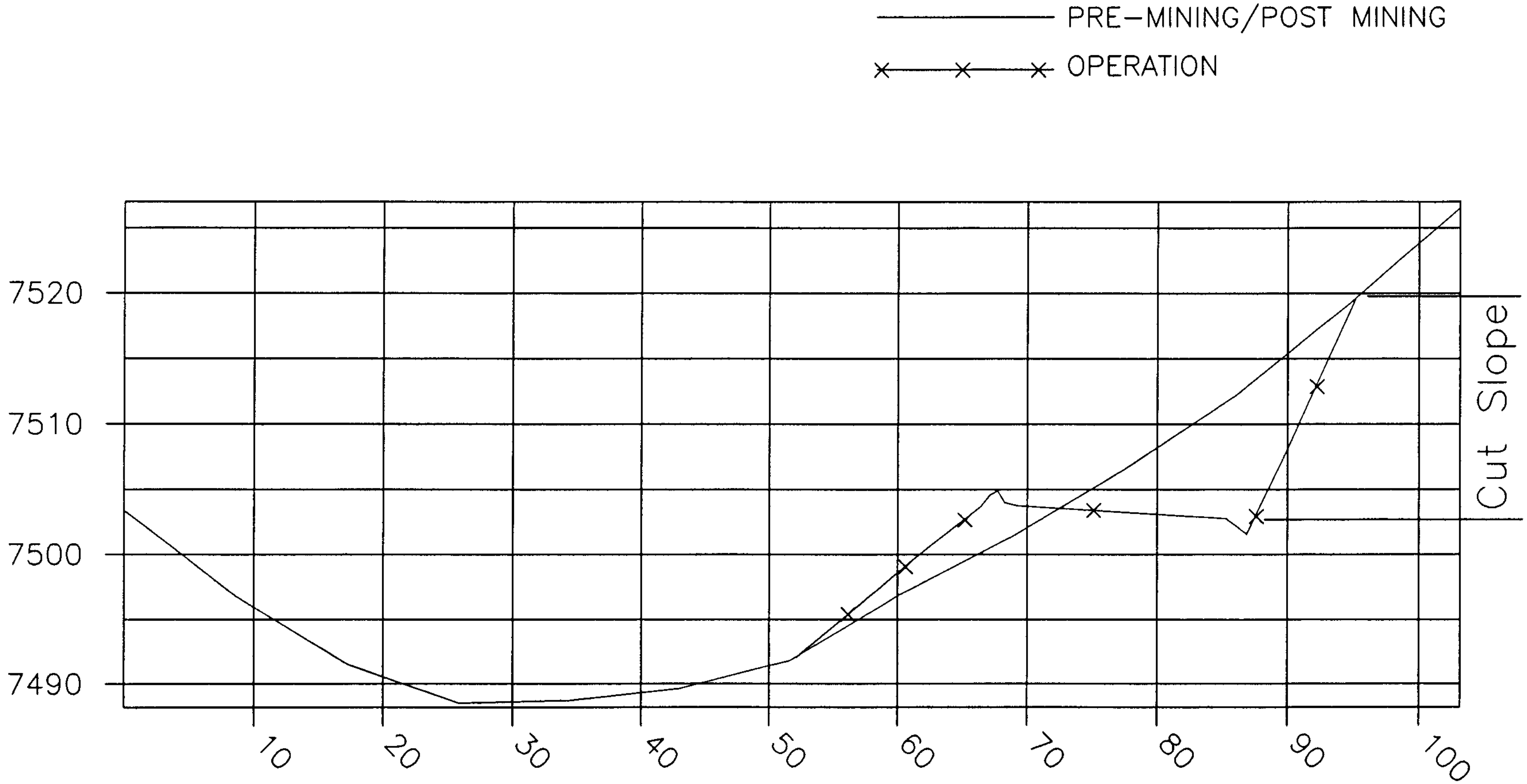
# UPPER CONVEYOR ACCESS ROAD

## STATION 3+00



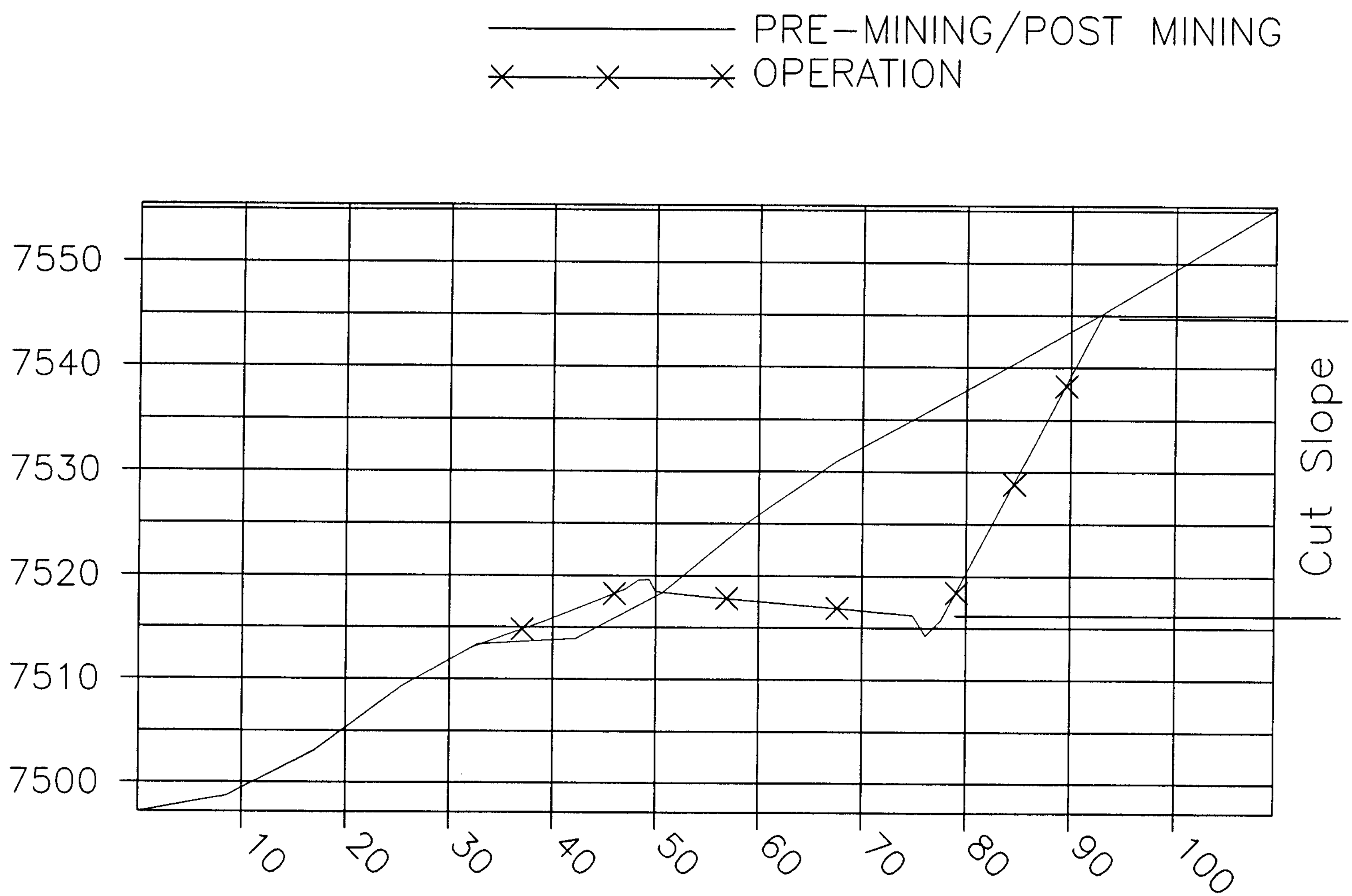
# UPPER CONVEYOR ACCESS ROAD

## STATION 4+00



# UPPER CONVEYOR ACCESS ROAD

## STATION 5+00



UPPER CONVEYOR ACCESS ROAD

STATION 6+00